S
625.76
H3mms
1981

Maintenance
management system

PHASE I EXTERNAL DESIGN

MONTANA

MMS

STATE DOCUMENTS COLLECTION

OCT 3 1990

MONTANA STATE LIBRARY
1515 E. 6th AVE.
HELENA, MONTANA 59620

PLEASE RETURN

BY BTML

MONTANA DEPARTMENT OF HIGHWAYS

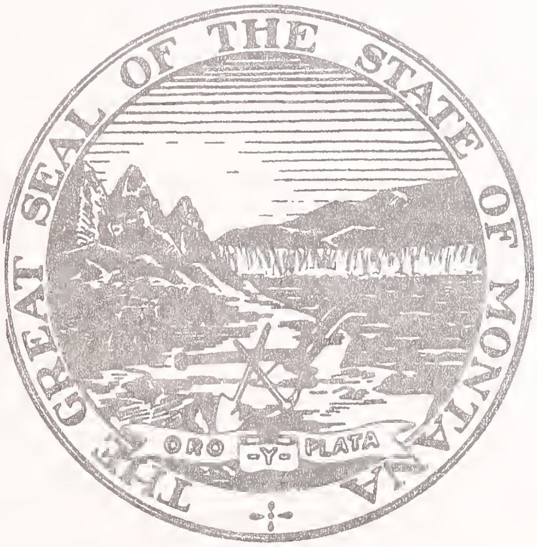
MONTANA STATE LIBRARY
S 625.76 H3mms 1981 c.1
Maintenance management system :phase I,
3 0864 00068632 2

MONTANA

DEPARTMENT OF HIGHWAYS

MAINTENANCE MANAGEMENT SYSTEM

PHASE I EXTERNAL DESIGN



By

BYRD, TALLAMY, MacDONALD, and LEWIS
CONSULTING ENGINEERS
Falls Church, Virginia

DECEMBER, 1981

Digitized by the Internet Archive
in 2015

https://archive.org/details/maintenancemanag1981mont

LLOYD G. BYRD
ROLAND H. BERGER

WILLIAM R. MASLIN
DOUGLAS H. BEESON
RAYMOND A. KOENIG

BYRD, TALLAMY, MACDONALD AND LEWIS
CONSULTING ENGINEERS
2921 TELESTAR COURT
MERRIFIELD P. O. BOX 504
FAIRFAX COUNTY, VIRGINIA 22116
TELEPHONE (703) 698-9780

BERTRAM D. TALLAMY
Founder, Retired

December 23, 1981

L.S. Harris, Coordinator
Management Information System
Montana Department of Highways
2701 Prospect Avenue
Helena, Montana 59620

Dear Mr. Harris:

We are pleased to transmit herewith the report entitled, "Phase I External Design, Montana MMS," within the time limits as specified and in accordance with the terms of our contract dated October 2, 1981. The draft copy of the report was used as part of the presentation of Phase I made to your Advisory Committee on December 16, 1981.

The schedule as developed for the total project in our proposal calls for a MDOH review period of ten days. It is my understanding that current plans are for the review to be completed by January 4, 1982, which meets this schedule and will permit the timely commencement of Phases II and III.

The successful completion of Phase I was due in a large part to the outstanding cooperation of employees of the Montana Department of Highways. You have every reason to be proud of both your organization and its fine personnel.

Sincerely yours,

Martin C Rissel

Martin C. Rissel
Project Director

MCR:nr:5E
Enclosure

A DIVISION OF WILBUR SMITH AND ASSOCIATES

PHASE I - EXTERNAL DESIGN

TABLE OF CONTENTS

Policy Statements - Road Maintenance Management System (Task 1.1) . Section 1

Plan - Maintenance Activities (Task 1.2) . . . . Section 2

Plan - Roadway Inventory (Task 1.3) . . . . Section 3

Plan - Budget and Work Program Subsystem Development (Task 1.4) . . Section 4

Plan - Maintenance Management User's Manual (Task 1.5) . . . . . . Section 5

Plan - MMS and MDOH Accounting System Interface (Task 1.6) . . . . Section 6

Plan - MMS and SBAS Interface (Task 1.7) . . . . Section 7

Plan - Management Information Subsystem Development (Task 1.8) . . Section 8

Plan - Equipment Shop Scheduling and Reporting (Task 1.9) . . . . . Section 9

Plan - Training Program (Task 1.10) . . . . Section 10

Plan - Data Processing System Design (Task 1.11) . . . . Section 11

Correspondence Regarding Phase I Approval . . . . Appendix

DH/cp/2140

POLICY STATEMENTS

ROAD MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 1

November, 1981

INTRODUCTION

These are policy statements which have been prepared in accordance with terms of the contract dated October 2, 1981 for a Road Management Maintenance System between the Montana Department of Highways and the firm of Byrd, Tallamy, McDonald and Lewis. The requirements for the development of policy statements are detailed as Task 1.1 in the proposal. These policies will establish broad outlines under which the Maintenance Management System (MMS) is to be developed and implemented. As the system is developed, the policies will be periodically reviewed to ascertain if the development of the system is within these policies and additionally, if a change in a policy is required. In the latter case, approval of the Advisory Committee will be required. At this writing, the MDOH personnel on the policy committee are: Don Gruel, Art Braut, Rusty Wrigg, John Prebil, Buck Harris, Don Lovely, and Bill Salisbury.

The policies have been developed in three broad areas:

A. Maintenance Service Levels and Related Effort Levels

B. Performance Standards

C. Work Monitoring Factors and Procedures

MAINTENANCE SERVICE LEVELS

POLICY:

Maintenance service levels are to be developed by Steering Committee subcommittees or personnel selected by the Steering Committee and approved by the Advisory Committee. They are to be established in a manner that will cause the Highway System, including its' appurtenances, to be preserved and kept up to as nearly as practicable its original as constructed condition or its subsequently improved condition.

DISCUSSION: Following acceptance of the maintenance service levels by the Advisory Committee, effort levels will be developed considering the total physical inventory and local conditions in terms of the commitment of resources to meet the requirements of the maintenance service levels. If insufficient funding is available to provide the resource requirements, those maintenance service levels which can be reduced with the least deleterious effect on the total system will be selected for review, and adjustment will be made on a

temporary basis. Service levels are to be sufficiently detailed and tied into activities to permit such selection and adjustment with maximum accuracy and minimum difficulty. The possibility of quality reduction due to financial limitations will be a key requirement when activities are developed and delineated.

POLICY:

Traffic operations service levels will be established by Steering Committee subcommittees or personnel selected by the Steering Committee and approved by the Advisory Committee that will cause the operation of the system and its incidental services to provide safe, convenient and economical transportation.

DISCUSSION: Following acceptance of the service levels by the Advisory Committee, effort levels will be developed considering conditions as they occur in various areas of the state, in terms of the commitment of resources to meet the requirements of the traffic operations service levels. If insufficient funding is available to provide the resource requirements, those traffic operation service levels that will have the least effect on the safety and convenience of the traveling pubic will be selected for review and adjustment. As in the case of maintenance items, service levels will be related to activities to permit the best possible selection.

POLICY:

Activities which are to be included in the Maintenance Management System will be grouped in a logical order, and will be consistent in both meaning and approach.

DISCUSSION: To permit the soundest possible approach to the establishment of service and effort levels for both maintenance and traffic operations, activities will be grouped in a logical and meaningful order. This will be done to permit easy recognition, rapid familiarity, and selection for summary reports needed for planning and budgeting. Typical groupings that will be used are: pavement; bridge repair; roadside; traffic services; minor construction; etc. To insure a uniform approach to both setting service levels and work measurement, activities will be consistent in both meaning and approach. They will always imply that an action has taken place and that at the least a

labor expenditure has occurred. (In some activities, overhead for example, labor would be the only expenditure which has taken place.) This consistency in approach will also permit true performance budgeting in all maintenance and traffic budgeting areas.

PERFORMANCE STANDARDS

POLICY:

The designation "Performance Standards" is to be eliminated and changed to "Activity Description and Accomplishment Method" with the acronym ADAM.

DISCUSSION: The Montana Department of Highways is currently engaged in the process of developing a performance evaluation system. This will be done over a considerable length of time and it is now being actively pursued in the upper level of the administrative hierarchy. Eventually it will include the entire Department and there is naturally some trepidation among many employees. As a result, the designation "Performance Standards" is a most unfortunate choice of words, particularly at this time. The designation will therefore be changed to "Activity Description and Accomplishment Method" as an alternate and this also has the advantage of a convenient acronym, ADAM.

POLICY:

ADAMs will apply to all divisions and sections of the state without exception.

DISCUSSION: ADAMs will apply to all divisions, but regional and highway class differences will be accounted for in establishing productivity rates. Each activity will have an ADAM and 100% of the work done in maintenance and traffic operations activities will be accounted for in an ADAM. As a result, all work in these fields may be planned, budgeted and scheduled. The use of resources in the accomplishment of these activities may then be captured and used with the budgeted amounts to continue refinement of the system as well as to contribute information needed for budgeting and programming.

POLICY:

"Other" work or "Miscellaneous" work in the various groupings will not be used to insure definitive descriptions of work done.

DISCUSSION: The use of these types of descriptions in groupings of this kind tend to collect an inordinate amount of expenditures and often can seriously degrade the value of a system. Consideration will also be given to adjusting highway classes to permit refinement of budgeting and expenditure procedures. Differences between two-lane interstates, four-lane interstates, four-lane primaries, two-lane primaries, and so on, are significant and present class definitions do not account for them to the degree where they may be easily and conveniently used for budget preparation, cost analysis, and cost collection.

POLICY:

Location of work defined by an ADAM will be from the present milepost referencing system.

DISCUSSION: Adoption of this policy will permit the tracking of costs to specific areas of interest and will provide information for planning construction and major maintenance efforts.

POLICY:

ADAMs are to include all necessary information to define the requirements for work and its performance:

DISCUSSION: ADAMs are to contain the following information:

Title
Description
Work Unit
Daily Production - Low, High, Average
Productivity Rate
Activity Requirements - Labor, Equipment, and Material per Activity Unit
Instructions for Coding Location - Referenced to Existing Milepost System
Instructions for Recording Work Accomplished
Description of Methods and Procedures
Condition Necessitating Activity
Level of Maintenance Work it is to Provide
Special Instructions as Required

Units of measurements for activities will be a finite, physical measurement whenever possible. If this is not feasible, a quantity of material used will be indicated and as a last possible choice, when there is no other reason-

able measure, labor hours will be used. ADAM committees will be established in number and makeup as required to assist in the development of salient future of ADAMs such as productivity, resource requirements, work method, quality guide, and special instructions.

POLICY:

The Maintenance Management System will track contract maintenance.

DISCUSSION: The tracking of contract maintenance will allow not only the collection and assignment of costs to activities, but will offer a method by which comparisons may be made with other means of performing the work.

POLICY:

ADAMs will be adjusted as required after implementation.

DISCUSSION: ADAMS are not static but must be adjusted over time as information is developed from the system itself. A means will eventually be developed to provide a continuing committee, preferably with some sort of automatic rotating membership, to periodically review and update ADAMs. It will actually be considered an incorrect implementation if reviews and the consequential changes resulting from these reviews are not made. ADAMs will be used for planning, scheduling, and budgeting. They will also be used as a means of establishing procedures for the accomplishment of work. They are the base on which the management system is to be constructed and will therefore serve as guides for all maintenance work performed. They are not, however, intended for use as a specific means of evaluating individual personnel performance or as an adjunct to any such system.

WORK MONITORING FACTORS AND PROCEDURES

POLICY:

Accomplishment of work that was done will be compared with that which was planned and scheduled.

DISCUSSION: Reports will be furnished to field maintenance supervisors and superintendents, generally indicating conformance with prepared schedules and productivity compared with that of the maintenance division to which they

are assigned. Reports will be furnished to administrative levels that will compare accomplishment with that which is planned. In every case, accomplishment will be shown per unit of resource in terms of time, money, and material as appropriate.

POLICY:

Exception reports will be the report method of choice whenever feasible.

DISCUSSION: It is recognized that modern data processing equipment can produce enormous amounts of paper in short periods of time and this can often prove destructive to a program rather than constructive. As a result, exception reports will be used as the norm whenever possible rather than detailed reports, particularly at higher administrative levels. Backup data in the form of detailed reports, however, will always be available on demand. As a general rule, the higher in the administrative hierarchy, the shorter the report and the more likely to be an exception report. Exception reports are to be tailored to the needs and desires of the various interested individuals. If at all possible, reports of work performed will be based on statistical distribution which means that crew performance and accomplishment will be compared against other crews and not some artifical criteria.

POLICY:

Training programs will stress the value of the system to employee and Department.

DISCUSSION: Training programs will be developed and provided to insure that everyone concerned is aware of the benefit to each individual and the ability to perform his/her job for the Department. This is of particular significance to the success of the entire project as motivation is needed to insure that the data which is collected is accurate. Without complete accuracy of information being collected and placed into the system, there is little or no value to the information and data which it provides.

POLICY:

A separate system will be developed for quality measurement.

DISCUSSION: It is understood that a maintenance management system as normally conceived and designed cannot directly account for quality. A sep-

arate review system, using sampling techniques, can be designed to overcome this deficiency to a substantial degree and this is recommended for implementation at some future date. Additionally, however, it is also recognized that correct attitudes toward planning, scheduling, and performing work, which are encouraged as an inherent part of the development of a maintenance management system, will lead to overall improvement in work performance. This improvement will tend to be self generating and as a result, a steady improvement in the quality of work is anticipated.

PLAN

MAINTENANCE ACTIVITIES

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 2

December 1981

PLAN
MAINTENANCE ACTIVITIES

On December 2, 1981 the MMS Steering Committee was assigned the task of reviewing and modifying the preliminary Maintenance Activity List, Activity Descriptions, Activity Accomplishment Units and the Activity Description and Accomplishment Method (ADAM) format. Each of these items, along with a description of activity numbering system are presented on the following pages.

ACTIVITY NUMBERING SYSTEM

Highway maintenance for management purposes is subdivided into maintenance activities. A maintenance activity is defined as a group of tasks or sub-tasks that are performed by one team at one location on the highway at one time to achieve a specific maintenance level.

The number of maintenance activities should be large enough to capture 100% of the maintenance related activities but at the same time small enough to be managed by both the maintenance and management personnel.

In order to insure consistent reporting of maintenance activities performed in each of the 11 field divisions, a 4-digit activity number has been assigned to each of the 81 activities.

The first digit indicates the type of work being done:

1 - Roadway
2 - Roadside
3 - Drainage
4 - Bridges
5 - Facilities
6 - Traffic Safety
7 - Winter Maintenance
8 - Material Production/Handling/Stockpiling
9 - Equipment/Supervision/Overhead

The second digit indicates one of the following 4 conditions:

1 - Maintenance Activity	These activities are designed to preserve and upkeep the highway and its elements.
2 - Service Activity	These activities are designed to provide a safe highway system.
3 - Betterment Activity	These activities are designed to improve, adjust or make additions to a highway system which more than restores it to its former condition.
4 - General Activity	These activities include material production, equipment maintenance, planning, scheduling, supervising and all approved absences.

The final 2 digits of the 4-digit activity numbers are a sequential listing.

DH:cp:214C

MAINTENANCE MANAGEMENT SYSTEM
ACTIVITY LIST

Activity No.	Activity Description	Work Unit
1101	Hand Patching	Square Feet
1102	Machine Patching	Square Yards
1103	Crack and Joint Sealing	Gallons
1104	Seal Coating - Hand or Fog	Square Yards
1105	Seal Coating - Sand/Slurry	Square Yards
1106	Seal Coating - Chip	Square Yards
1107	Rejuvenation - Asphalt Surface	Lane Mile
1108	Blading and Restoring Unpaved Surfaces & Shoulders	Mile
1109	Base Repair	Cubic Yards
1110	Mudjacking	CF of Grout
1111	Repair Concrete Pavements	Square Feet
1112	Heater Planing - Scarification	Square Yards
1201	Sweeping and Cleaning Pavements	Pass Mile
1301	Betterment Work - Roadway	Man Hours
2101	Path, Trail and Sidewalk Maintenance	Linear Feet
2102	R/W Fence and Gate Repair	Linear Feet
2103	Cattle Guard Repair	Each
2201	Mowing	Swath Mile
2202	Maintenance of Landscaped Areas	Acres
2203	Brush and Tree Cutting	Acres
2204	Chemical Spraying	Acres
2205	Litter Pickup	Cubic Feet
2301	Betterment Work - Landscaping	Acres
3101	Cleaning Culverts, Catch Basins and Inlets	Each
3102	Repairing Drainage Structures	Each
3103	Replacing Culverts - Up to 48" Diameter	Each
3104	Replacing Culverts - Larger than 48" Diameter	Each
3105	Replacing Catch Basins, Inlets and Manholes	Each
3106	Cleaning and Shaping Ditches	Linear Feet
3107	Repairing Paved Ditches	Square Feet
3108	Slope Repair - Slides and Washouts	Cubic Yards
3109	Repair of Erosion Control Features	Each
3110	Drainage Pump Station Repair	Each
3111	Replace Miscellaneous Concrete Appurtenances	Cubic Feet
3112	Repair Miscellaneous Concrete Appurtenances	Cubic Feet
3301	Betterment Work - Drainage	Each
4101	Structure Painting	Gallons
4102	Repair Timber Structures	Man Hours
4103	Bridge Deck Repair	Square Feet
4104	Repair or Replace Structural Steel	Man Hours
4105	Substructure Concrete Repair	Square Feet
4106	Expansion Joint Repair	Linear Feet
4107	Bridge Curb and Railing Repair	Linear Feet
4201	Bridge Inspection	Each
4301	Betterment Work - Bridge Structures	Each

Activity No.	Activity Description	Work Unit
5201	Yard and Shop Maintenance	Each Facility
5202	Rest Area Maintenance	Each Rest Area
5203	Rest Area Repair	Each Rest Area
5301	Betterment Work - Facilities	Each
6101	Sign Installation, Replacement or Maintenance - Single Post	Each Sign Location
6102	Sign Installation, Replacement or Maintenance - Multiple Post	Each Sign Location
6103	Sign Installation, Replacement or Maintenance - Overhead Signs and Panels	Each Sign
6104	Delineator Posts, Reflectors and Milepost Markers - Installation Repair or Replace	Each
6105	Guard Rail Replacement	Linear Feet
6106	Guard Rail Repair	Linear Feet
6107	Guard Rail Painting	Linear Feet
6108	Pinned Down Curb Replacement	Linear Feet
6109	Roadway and Sign Lighting	Each Light
6110	Beacon and Flashing Light Maintenance	Each Light
6111	Crash Barrier Maintenance	Each Location
6201	Pavement Striping	Pass Mile
6202	Placement and/or Removal of Messages	Square Feet
6203	Routine Roadway Inspection	Mile
6204	Sign, Guard Rail and Luminaire Standard Inspection	Mile
6301	Betterment Work - Guard Rail	Linear Feet
6302	Betterment Work - Lighting	Each
6303	Betterment Work - Traffic Signals	Each
7201	Snow Plowing	Plow Mile
7202	Application of De-icing Chemicals and/or Abrasives	Spread Mile
7203	Snow Fence Installation, Repair or Removal	Linear Feet
8401	Aggregate Production	Cubic Yards
8402	Premix Production	Cubic Yards
8403	Salt/Sand Mix Production	Cubic Yards
8404	Hauling Bulk Materials	CY-Mile
8405	Hauling Maintenance Supplies	Man Hours
8406	Stockpiling Materials	Cubic Yards
9401	Equipment Maintenance	Man Hours
9402	Planning, Scheduling and Supervising	Man Hours
9403	Training	Man Hours
9404	Work for Others	Man Hours
9405	Approved Absence	Man Hours

HAND PATCHING

SQUARE FEET 1101

Patching small areas of bituminous roadway and shoulder surfaces with hot or cold bituminous material to correct abrupt depressions, pot holes, edge failures and other potential surface hazards. Also includes patching P.C.C. pavements with bituminous concrete and patching utilizing the portable asphalt recycling machine.

MACHINE PATCHING

SQUARE YARDS 1102

Patching areas of bituminous surface roadway and shoulder surfaces, less than 500 feet in length or averaging less than 3/4 of an inch in thickness, to correct cracking, raveling, spalling, restore skid resistance and prevent further deterioration of surface.

CRACK AND JOINT SEALING

GAL. OF FILLER MATERIAL 1103

Cleaning and filling cracks and joints in the roadway surface and at the edge joint to seal and prevent the penetration of water and the intrusion of incompressibles.

SEAL COATING - HAND OR FOG

SQUARE YARDS 1104

Application of a road oil to pothole patches and covering with sand or chips.

SEAL COATING - SAND/SLURRY

SQUARE YARDS 1105

Application of a sand or slurry coat to continuous sections of bituminous roadway surfaces to seal cracks or rejuvenate dry weathered surfaces to prevent further surface deterioration.

SEAL COATING - CHIP

SQUARE YARDS 1106

Application of a chip coat to continuous sections of bituminous roadway surfaces to seal cracks or rejuvenate dry weathered surface to prevent further surface deterioration or to improve skid resistence.

REJUVENATION - ASPHALT SURFACE LANE MILE 1107

Application of rejuvenator agent to continuous sections of bituminous roadway surfaces.

BLADING AND RESTORING UNPAVED SURFACES AND SHOULDERS MILE 1108

Blading, shaping and smoothing gravel or earth surfaces, adding material or widening to restore proper shape thus providing a smooth riding surface.

BASE REPAIR CUBIC YARDS 1109

Removal and replacement of small areas of bituminous roadway, shoulder surfaces and P.C.C. pavement, including removal and replacement of base material using bituminous material and required base material to correct severe cracking, up heavals, pothole clusters and base failures.

MUDJACKING CF OF GROUT 1110

Raising and leveling concrete slabs by pumping slurry mix underneath the slab, including drilling and capping holes in pavement to eliminate surface hazards caused by settlements; restore grade line and fill voids beneath the pavements.

REPAIR CONCRETE PAVEMENTS SQUARE FEET 1111

Removal and replacement of areas of P.C.C. roadway and shoulder surface with P.C.C. to correct buckling, severe cracking, scaling or spalling. Also, includes the grinding of concrete pavements.

HEATER PLANING - SCARIFICATION SQUARE YARDS 1112

Heating bituminous roadway surfaces and planing-scarification to obtain a smooth riding surface.

SWEEPING AND CLEANING PAVEMENTS PASS MILE 1201

Mechanical sweeping of dirt and debris from paved surface shoulders, along curbs and gutters and along median barriers to prevent disruption of roadway drainage and maintain environmental and aesthetic quality.

BETTERMENT WORK - ROADWAY MAN HOURS 1301

The construction of additional sections of roadways such as turning lanes, climbing lanes, etc. including embankment, base and pavements. Also upgrading of gravel roadways to paved surfaces and overlays greater than 3/4" in thickness.

PATH, TRAIL AND SIDEWALK MAINTENANCE LINEAR FEET 2101

Repair, replacement or maintenance of gravel, bituminous or P.C.C. bicycle paths, hiking trails and sidewalks to eliminate hazardous conditions.

R/W FENCE AND GATE REPAIR LINEAR FEET 2102

Repair or replacement of fence posts, fabric, top rails, gates located on or within the right-of-way limits.

CATTLE GUARD REPAIR EACH 2103

Repair or replacement of cattle guards.

MOWING SWATH MILE 2201

Grass and weed cutting for safety purposes to maintain sight distances at intersections or in front of signs, to maintain proper drainage, control noxious weeds, improve aesthetic values, reduce fire danger and reduce snow drifting.

MAINTENANCE OF LANDSCAPED AREAS ACRES 2202

Mowing with hand and small riding mowers and the mechanical or manual distribution of seed, sod or fertilizer to control noxious weeds, and erosion problems and improve the aesthetic value. This activity also includes the maintenance of sprinkler systems.

BRUSH AND TREE CUTTING ACRES 2203

Cutting and removing of brush and trees for safety purposes to maintain sight distance on curves, intersections, and front of signs or to reduce snow drifting and shading of roadway.

CHEMICAL SPRAYING ACRES 2204

Chemical treatment of turf acres to control or prevent the growth of vegetation usually around sign posts, guard rail posts, curbs and shoulders.

LITTER PICKUP CUBIC FEET 2205

Cleaning and disposal of litter on Right-of-Way including pickup, loading, hauling and disposing of litter at designated location. This also includes removal of hazardous material from the roadway.

BETTERMENT WORK - LANDSCAPING ACRES 2301

The installation of trees, shrubs, plants, grass and other landscaping items necessary to provide a new major landscaped area.

CLEANING CULVERTS, CATCH BASINS AND INLETS EACH 3101

Mechanical or hand cleaning of culverts, catch basins or inlets to remove accumulated dirt and debris to maintain adequate drainage.

REPARING DRAINAGE STRUCTURES EACH 3102

Repairing catch basins, drop inlets, manholes and culverts which have deteriorated or been damaged and restoring them to a workable condition.

REPLACING CULVERTS-THRU 48" DIAMETER EACH 3103

Replacing culverts and irrigation facilities which have deteriorated or failed to restore them to a workable condition. This includes all culverts 48" in diameter and smaller.

REPLACING CULVERTS-LARGER THAN 48" DIAMETER EACH 3104

Replacing culverts and irrigation facilities which have deteriorated or failed to restore them to a workable condition. This includes all culverts larger than 48" diameter.

REPLACING CATCH BASINS, INLETS AND MANHOLES EACH 3105

Replacing catch basins, drop inlets and manholes which have deteriorated or failed and require replacement to be restored to a workable condition.

CLEANING AND SHAPING DITCHES LINEAR FEET 3106

Cleaning and shaping roadside ditches, including the removal, hauling and disposing of excess material in order to restore proper grade line and side slope configuration to assure adequate drainage.

REPAIRING PAVED DITCHES SQUARE FEET 3107

Patching and partial or full replacement of paved ditch sections to correct damage or deterioration and restore proper drainage.

SLOPE REPAIR - SLIDES AND WASHOUTS CUBIC YARDS 3108

Repair and maintenance of unpaved slopes which have been damaged due to washouts or other erosion problems. This activity includes the placement of rip-rap.

REPAIR OF EROSION CONTROL FEATURES EACH 3109

Repair of paved, concrete or metal erosion control features.

DRAINAGE PUMP STATION REPAIR EACH 3110

Mechanical, electrical or other maintenance or repair required at the drainage pump stations to insure proper operations.

REPLACE MISCELLANEOUS CONCRETE APPURTENANCES CUBIC FEET 3111

Replacement of curb and gutter, urban median, retaining walls, New Jersey barrier and other miscellaneous concrete appurtenances.

REPAIR MISCELLANEOUS CONCRETE APPURTENANCES CUBIC FEET 3112

Repair of curb and gutter, urban median, retaining walls, New Jersey barrier and other miscellaneous concrete appurtenances.

BETTERMENT WORK - DRAINAGE EACH 3301

The installation of new drainage facilities such as ditches, culverts and pipes at new locations.

STRUCTURE PAINTING GALLONS 4101

Cleaning and painting of structural members, including handrails and bridge guard rail, to prevent deterioration.

REPAIR TIMBER STRUCTURES MAN HOURS 4102

Repair or replacement of timber piles, pile bents, caps or deck to maintain safety and load carrying capacity.

BRIDGE DECK REPAIR SQUARE FEET 4103

Patching concrete bridge decks with concrete, epoxy, mortar, steel or other materials to correct potholes and other surface defects. Also included in this activity is the patching of bituminous overlayed bridge decks with bituminous premix.

REPAIR OR REPLACE STRUCTURAL STEEL MAN HOURS 4104

Repair or replacement of steel piles, stringers, floor beams, truss members or bracing to maintain safety and load carrying capacity.

SUBSTRUCTURE CONCRETE REPAIR SQUARE FEET 4105

Reparing and patching piers, abutments, retaining walls, and concrete bridge structure below the deck with concrete, epoxy, mortar or other material to correct damaged or deteriorated areas.

EXPANSION JOINT REPAIR LINEAR FEET 4106

Repairing and replacing of bridge expansion joints.

BRIDGE CURB AND RAILING REPAIR LINEAR FEET 4107

Repair or replacement of bridge curbs, medians, parapets and railing damaged by accident or deterioration to restore safe conditions for motorist and pedestrians.

BRIDGE INSPECTION EACH 4201

Provide assistance with bridge inspection including bridge approaches, expansion devices, deck, curb, rails, beams, paint system, piers, pier caps, abutments, drainage system including debris accumulation and all other accessble areas.

BETTERMENT WORK - BRIDGE STRUCTURES	EACH	4301	The installation of new bridges, drainage structures or sign bridges or the major modification or addition to any such structures.
YARD AND SHOP MAINTENANCE	EACH FACILITY	5201	General maintenance and cleanup of yards and shops at field maintenance locations and other Department building locations.
REST AREA MAINTENANCE	EACH REST AREA	5202	General maintenance and cleanup of rest area building and grounds including litter barrel service.
REST AREA REPAIR	EACH REST AREA	5203	Repair of rest area buildings and grounds due to deterioration and vandalism.
BETTERMENT WORK - FACILITIES	EACH	5301	The construction of new facilities or the major modification or addition to existing facilities.
SIGN INSTALLATION, REPLACEMENT OR MAINTENANCE - SINGLE POST	EACH LOCATION	6101	Repair, installation, replacement, straightening and cleaning of single post signs, sign post and historical markers damaged by accident, vandalism or deterioration to restore and maintain adequate control and guidance of traffic.

SIGN INSTALLATION, REPLACEMENT OR MAINTENANCE - MULTIPLE POST EACH LOCATION 6102

Repair, installation, replacement, straightening and cleaning of mutiple post signs and sign posts damaged by accident, vandalism or deterioration to restore and maintain adequate control and guidance of traffic.

SIGN INSTALLATION REPLACEMENT OR MAINTENANCE - OVERHEAD SIGNS AND PANELS EACH SIGN 6103

Repair, installation, replacement and cleaning of overhead signs and sign panels and supports that have been damaged by accident, vandalism or deterioration to restore and maintain adequate control and guidance of traffic.

DELINEATOR POSTS, REFLECTORS AND MILEPOST MARKERS - INSTALLATION, REPAIR OR REPLACE EACH 6104

Installation, straightening, and repairing delineators, and milepost markers to maintain adequate traffic control and provide motorist information. This activity also includes the installation, maintenance and removal of snow poles.

GUARD RAIL REPLACEMENT LINEAR FEET 6105

Replacement of guard rail sections, posts and hardware damaged by accident or vandalism or normal deterioration.

GUARD RAIL REPAIR LINEAR FEET 6106

Repair of guardrail sections, posts and hardware damaged by accident, vandalism.

GUARD RAIL PAINTING LINEAR FEET 6107

Painting of guard rail sections, posts and hardware damaged by accident, vandalism or normal deterioration.

PINNED DOWN CURB REPLACEMENT LINEAR FEET 6108

Replacement of pinned down curb to provide safe channelization of traffic.

ROADWAY AND SIGN LIGHTING EACH LIGHT 6109

Repair and maintain roadway and sign lighting to correct failures and malfunctions and to insure safe operation conditions.

BEACON AND FLASHING LIGHT MAINTENANCE EACH LIGHT 6110

Repair or replace beacons, flashing lights and traffic signals to warn motorists of changes in roadway features (sharp curve, interstate ends), and to control traffic.

CRASH BARRIER MAINTENANCE EACH LOCATION 6111

Repair or replacement of traffic crash barriers deteriorated or damaged by accident or vandalism to restore or maintain adequate protection to the traveling public.

PAVEMENT STRIPING PASS MILE 6201

Painting centerline, edgelines and lane marking to provide adequate traffic control. This also includes the spotting of roadways.

PLACEMENT AND/OR REMOVAL OF PAVEMENT MARKINGS   SQUARE FEET   6202

Placement of messages on the roadway surface to provide well defined markings for vehicular and pedestrian traffic control including stop bars, cross walks, arrows, traffic islands and hazard stripes. Also included in this activity is the removal of undesirable messages and lines on the roadway or roadside.

ROUTINE ROADWAY INSPECTION   MILE   6203

Routine patrolling of roadway to watch for and control hazardous conditions. This would also include sign reflectivity inspection.

SIGN, GUARD RAIL AND LUMINAIR STANDARD INSPECTION   MILE   6204

Routine physical inspection of signs, guard rail and luminair standards to insure proper tension on cables and proper torque on bolts.

BETTERMENT WORK - GUARD RAIL   LINEAR FEET   6301

The installation of new guard rail or New Jersey concrete barrier at new locations.

BETTERMENT WORK - LIGHTING   EACH   6302

The installation of any new roadway or bridge lighting, including the poles, standards, supports, bases, and necessary wiring.

BETTERMENT WORK - TRAFFIC SIGNALS   EACH   6303

The installation of new traffic signals at new locations including the power lines and support structures.

SNOW PLOWING   PLOW MILE   7201

Removing snow and ice from the roadway, shoulders and ramps, plowing, blowing or blading with trucks, rotary or graders to keep roads open to traffic and reduce hazardous driving conditions.

APPLICATION OF DE-ICING CHEMICALS AND/OR ABRASIVES SPREAD MILE 7202

Applying de-icing chemicals and/or abrasives to continuous sections or isolated spot locations or roadways, shoulders and ramps.

SNOW FENCE INSTALLATION, REPAIR OR REMOVAL LINEAR FEET 7203

The erection, repair and removal of snow fence.

AGGREGATE PRODUCTION CUBIC YARDS 8401

Producing all types of mineral aggregates. Includes operation of the portable crushing machine or screening plants.

PREMIX PRODUCTION CUBIC YARDS 8402

Production of premix by drum dryer mixer or road mix method.

SALT/SAND MIX PRODUCTION CUBIC YARDS 8403

Mixing of salt and sand for use in snow and ice control.

HAULING BULK MATERIALS

CY-MILE 8404

Hauling of all types of mineral aggregates, sand, salt and any other bulk maintenance materials.

HAULING MAINTENANCE SUPPLIES MAN HOURS 8405

Hauling of all maintenance supplies from storage in one location to storage in another location. This does not include the hauling of supplies from storage to the work site for installation.

STOCKPILING MATERIALS CUBIC YARDS 8406

Stockpiling of all types of mineral aggregates, sand, salt and any other maintenance materials.

EQUIPMENT MAINTENANCE MAN HOURS 9401

Maintenance or repair of equipment by field maintenance personnel. Also transportation of equipment from one location to another for repairs.

PLANNING, SCHEDULING AND SUPERVISING MAN HOURS 9402

Planning and scheduling of maintenance activities, inspection of maintenance worksites, and other administrative duties performed by field personnel.

TRAINING MAN HOURS 9403

Training conferences and safety meetings held to assist maintenance personnel in the proper performance of their job functions.

WORK FOR OTHERS MAN HOURS 9404

All work done by Maintenance forces for other MDOH department such as Engineering, Traffic Unit, Construction Bureau, Building Maintenance and the Motor Pool and Equipment Division. This activity shall not be used to report work done for agencies outside the Department of Highways (FHWA, cities, counties) or for routine maintenance activities on the State system.

APPROVED ABSENCE MAN HOURS 9405

All time charged by Maintenance forces to holidays, annual leave, sick leave, jury duty, military leave and all other approved absences.

DH/dk/202C

MONTANA DEPARTMENT OF HIGHWAYS

ACTIVITY DESCRIPTION AND ACCOMPLISHMENT METHOD

MAINTENANCE MANAGEMENT SYSTEM

ACTIVITY NAME	WORK UNITS	ACTIVITY NO.

ACTIVITY DESCRIPTION

QUALITY GUIDE

CONDITION

SERVICE LEVEL

MAINTENANCE LEVEL

RECOMMENDED CREW SIZE

RECOMMENDED EQUIPMENT

NO.	DESCRIPTION	CODE

AVERAGE ACCOMPLISHMENT RATE

DAILY ACCOMPLISHMENT

LOW	AVERAGE	HIGH

RECOMMENDED MATERIAL

QUANTITY (per work unit)	DESCRIPTION	CODE

ACCOMPLISHMENT METHOD

LOCATION AND ACTIVITY REPORTING

SPECIAL INSTRUCTIONS

APPROVAL	DATE
ADMINISTRATOR MAINTENANCE DIVISION	

PLAN

ROADWAY INVENTORY

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 3

December 1981

TABLE OF CONTENTS

Page

General 3-1

Inventory Collection 3-1

Standard Heading Information 3-5

Inventory Count Form 3-6

Inventory Length Form 3-10

APPENDICES

Appendix A, Physical Inventory Items to be Collected or Checked in the Field 3-14

Appendix B, Definition of Physical Inventory Items to be Collected in Field 3-16

Appendix C, Standard Size for Painted Pavement Messages 3-19

ADDENDUMS

Addendum #1 3-23

Addendum #2 3-27

MAINTENANCE MANAGEMENT SYSTEM
INSTRUCTIONS FOR PREPARATION OF THE ROADWAY INVENTORY

GENERAL

In developing a "Maintenance Management System" one of the important parts of the basic information required is a count, or inventory, of the significant physical features of the highway system that provides the basis of the maintenance workload or the total amount of work which must be done to properly maintain the system. These features include lane miles of pavement, length of guardrail and all other such items that individually and collectively require maintenance work or which affect the amount of maintenance work to be done.

In addition, other inventory items include roadway design, environmental and traffic features. Since use of these additional features is primarily of importance in the mathematical modeling process for budgeting purposes, the procedures for preparing inventories of these items is not addressed here.

The physical inventory, in conjunction with work performance, material and equipment costs, is used primarily in the budgeting process.

The inventory will be obtained from three sources:

1. Information on store in the state's computer records.
2. Information on record in state headquarters offices.
3. Information from field measurements and counts.

INVENTORY COLLECTION

The collection of the inventory will be organized and supervised by a member of the State Maintenance Management Team from the Helena office.

An inventory must be made carefully and under uniform rules. When questions arise in compiling the inventory, the answer should not be the result of a guess. Refer all such questions to the Project Coordinator of the Maintenance Management System.

Field Inventory Operations

The field inventory team should consist of three members:

A Driver who operates the vehicle in which the team is traveling.

Travel speed or frequency of stops while observing will vary with the number of features encountered on the highway. The driver will observe and call out the odometer readings when required.

An Observer who visually spots and identifies the roadway feature to be inventoried and determines the number of units to be recorded. The observer calls out this information to the Recorder, the third member of the team.

Two members of the inventory team will be assigned to serve for the complete inventory in the District. The third member will be the Supervisor for the section in which the inventory is being taken at that time. Assignments as Driver, Observer and Recorder can be rotated among the team members to reduce fatigue while performing the tasks except that the Supervisor shall not act as Recorder.

Accuracy

Extreme accuracy is not required in determining dimensions for the inventory. It is believed that the inventory team can proceed between 5 and 10 miles per hour in recording data, stopping only when required to obtain information that cannot be seen or measured from the car odometer. In this connection, a car equipped with an odometer reading to the 100th of a mile should be used. The inherent inaccuracy of most odometers is of little consequence because reference will be made to mileposts. Experience of the team will quickly determine the most appropriate measuring method. For distances that cannot be measured by odometers the distance may be measured by pacing.

Safety

Cars will be equipped with an amber flashing light and a red flourescent triangle indicating a slow moving vehicle. These and other safety measures that may be appropriate will be observed at all times. Safety vests will be worn by team members. Extreme caution must be exercised at all times when walking back and forth across the highway.

Locations Under Construction

Roadway sections under construction must not be inventoried. The inventory will be taken upon completion of the construction project following acceptance by the District.

Construction areas necessitate closing the inventory up to the point where construction begins. The inventory must then be resumed at the point at which construction ends.

Inventory Input Forms

The inventory has been logically categorized for ease in reporting the various inventory elements. Each form has a similar type of heading with a few exceptions which are utilized to identify the type of information being reported. The forms are shown on Figure 1.

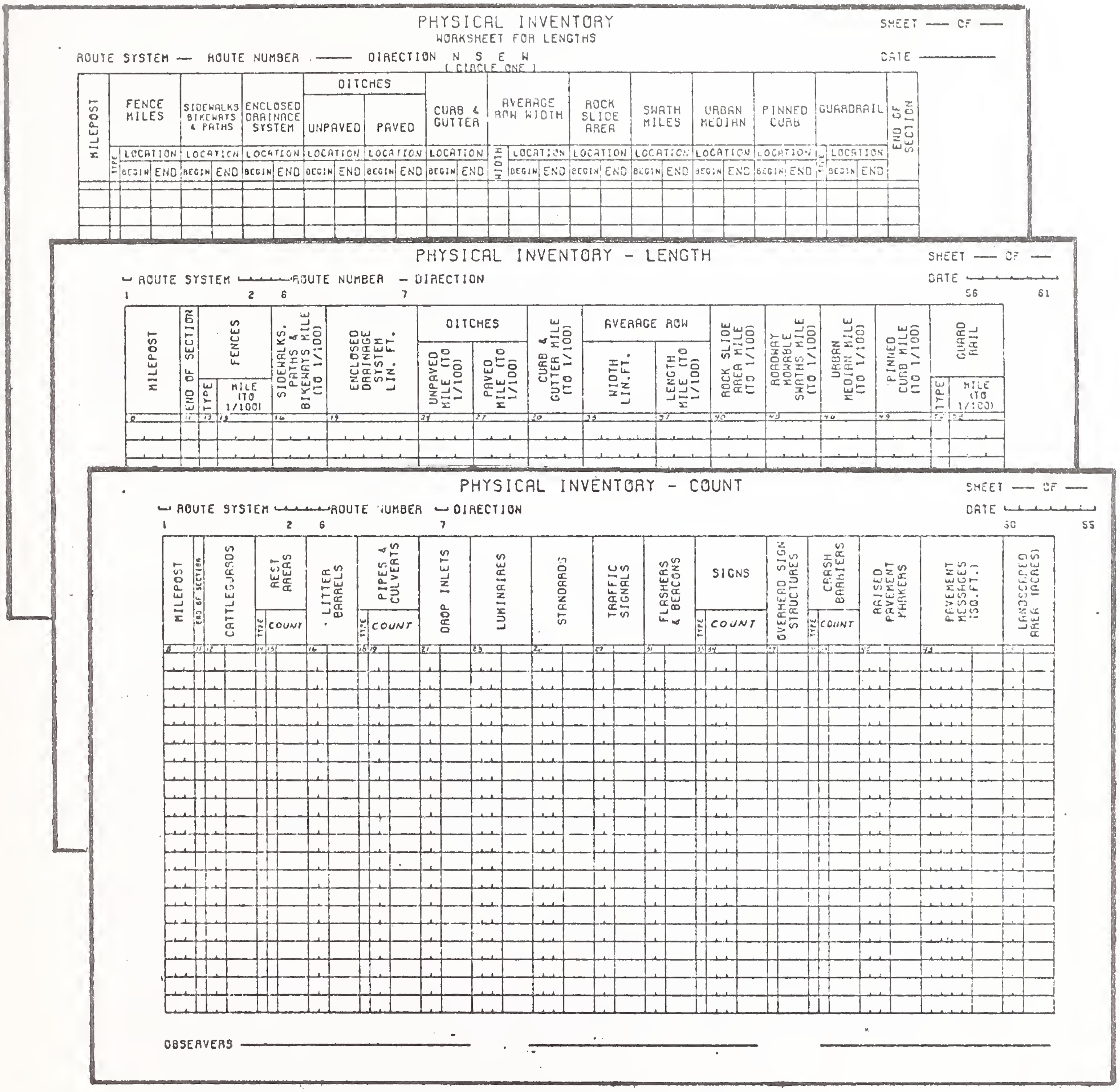
Since the inventory is to be used to produce each section budget an extra amount of diligence should be exercised to insure accuracy in reporting. No less important is the need for clear and legible coding. These documents will be the original source document for the inventory, and as such, all of the information will be taken directly from the forms by keypunch personnel. In many cases, the keypunch personnel are not knowledgeable concerning the information being keypunched and will record only information as they see it. It should be noted that only those items maintained by MDOH should be included in this inventory. Again, be accurate, clear and concise.

The following sections will explain the information areas on the forms with specific examples of the information as it would actually be recorded in the field.

STANDARD HEADING INFORMATION

Sheet Number

Show the successive number for each sheet of inventory log for each section's inventory.



PHYSICAL INVENTORY
WORKSHEET FOR LENGTHS

SHEET —— OF ——

ROUTE SYSTEM —— ROUTE NUMBER —— DIRECTION N S E W (CIRCLE ONE)

DATE ——

MILEPOST	FENCE MILES			SIDEWALKS BIKEWAYS & PATHS		ENCLOSED DRAINAGE SYSTEM		DITCHES				CURB & GUTTER		AVERAGE ROW WIDTH			ROCK SLIDE AREA		SWATH MILES		URBAN MEDIAN		PINNED CURB		GUARDRAIL			END OF SECTION
								UNPAVED		PAVED																		
	TYPE	LOCATION		LOCATION		LOCATION		LOCATION		LOCATION		LOCATION		WIDTH	LOCATION		LOCATION		LOCATION		LOCATION		LOCATION		TYPE	LOCATION		
		BEGIN	END	BEGIN	END	BEGIN	END	BEGIN	END	BEGIN	END	BEGIN	END		BEGIN	END	BEGIN	END	BEGIN	END	BEGIN	END	BEGIN	END		BEGIN	END	

PHYSICAL INVENTORY - LENGTH

SHEET —— OF ——

ROUTE SYSTEM —— ROUTE NUMBER — DIRECTION

DATE ——

1 2 6 7 56 61

MILEPOST	END OF SECTION	FENCES		SIDEWALKS, PATHS & BIKEWAYS MILE (TO 1/100)	ENCLOSED DRAINAGE SYSTEM LIN. FT.	DITCHES		CURB & GUTTER MILE (TO 1/100)	AVERAGE ROW		ROCK SLIDE AREA MILE (TO 1/100)	ROADWAY MOWABLE SWATHS MILE (TO 1/100)	URBAN MEDIAN MILE (TO 1/100)	PINNED CURB MILE (TO 1/100)	GUARD RAIL	
		TYPE	MILE (TO 1/100)			UNPAVED MILE (TO 1/100)	PAVED MILE (TO 1/100)		WIDTH LIN.FT.	LENGTH MILE (TO 1/100)					TYPE	MILE (TO 1/100)

PHYSICAL INVENTORY - COUNT

SHEET —— OF ——

ROUTE SYSTEM —— ROUTE NUMBER — DIRECTION

DATE ——

1 2 6 7 50 55

MILEPOST	END OF SECTION	CATTLEGUARDS	REST AREAS		LITTER BARRELS	PIPES & CULVERTS		DROP INLETS	LUMINAIRES	STANDARDS	TRAFFIC SIGNALS	FLASHERS & BEACONS	SIGNS		OVERHEAD SIGN STRUCTURES	CRASH BARRIERS		RAISED PAVEMENT MARKERS	PAVEMENT MESSAGES (SQ.FT.)	LANDSCAPED AREA (ACRES)
			TYPE	COUNT		TYPE	COUNT						TYPE	COUNT		TYPE	COUNT			

OBSERVERS ________________ ________________ ________________

FIGURE I INVENTORY FORMS

Route System

Enter the type of system in Column 1 using I for Interstate, P for Primary, S for Secondary, O for Off-system routes, and F for Frontage Roads.

Route No.

Enter the Federal-aid route number in Column 2-6 as shown on the milepost markers, not the posted motorist route. For frontage roads the same route number as the highway which the frontage road borders shall be used with the addition that an "E" or "W" shall be entered in column 2 for frontage which border a North - South route (ie. I-15) to indicate they are on the east or west side. Similiarly, an "N" or "S" shall be entered in column 2 for frontage roads which border an East - West route (ie. I-90, I-94) to indicate they are on the north or south side.

Direction

Show the direction in Column 7 on all roads in which the survey is taken. The inventory should be taken in the direction of increasing milepost numbers. On multi-lane divided roadways, the survey will be made in each direction and the direction shown as indicated on the milepost panel, but the reference must still be from lower number to higher number.

Date

Show the calendar date on which the survey is performed and code into Columns 43-48. An example would be December 9, 1981 which would be coded

__________.

Observers

Show last name and initials of the three members of the observing team at the bottom of each sheet.

Comments

The back of the form is to be used for making any comments that may be related to the inventory.

INVENTORY COUNT FORM

The first type of form is used to record roadway features that occur between consecutive milepost markers. An example would be the number of cattleguards. The inventory recorder will show the number of units of that item within the milepost segment from the beginning milepost marker. To assist in keeping track of the count, space has been provided next to each item so that a running tickwork count or other values can be kept. Multiple lines can be used for any milepoint to milepoint segment. For the purpose of inventory, ramps to the interstate shall be considered part of the interstate and items on them shall be included in Interstate count to the point where the ramp pavement contacts the pavement of the intersecting roadway.

Milepost (Columns 8-10)

This area is used to code in the beginning milepost reference point.

End of Section (Column 11)

This is used in conjunction with the milepost field to note the reference point where a maintenance section begins or ends. The closest 1/10 of a mile in which the section begins or ends is coded in Column 11.

Cattleguards (Columns 12-13)

The number of cattleguards installed in the highway ROW and maintained by the MDOH.

Rest Areas - Type (Column 14)

This field is used to code in the type of any rest area within the milepost markers. If more than one type of rest area is located in the segment, use additional lines to code the information. The codes to use for the different types are as follows:

M - Rest Area with modern facilities
P - Rest Area with primitive facilities
N - Rest Area with no facilities

Rest Areas - Count (Column 15)

The number of each of the types of rest areas noted in Column 14 should be coded in this column.

Litter Barrels (Columns 16-17)

The number of litter barrels placed along the side of the road for the motoring public. These do not include those barrels located within rest areas.

Pipes, Culverts and Small Bridge - Type (Column 18)

This column is used to designate the type of pipe, culvert or small bridge located within the segment. If more than one type is within the segment, then multiple lines should be used. The following codes are to be used:

C - Cross Culverts up thru 48"
M - Cross Culverts over 48" to 10'
L - Box Culverts (small bridges) 10' to 20'
S - Side Pipes and Culverts

Pipes, Culverts and Small Bridges - Count (Columns 19-20)

The number of each type of pipe or bridge, as coded in Column 18, located within the segment.

Drop Inlets (Columns 21-22)

The number of drop inlets, catch basins, manholes, etc. that are maintained by the MDOH.

Luminaires (Columns 23-25)

This field is used to record the number of luminaires, or light heads, that the State is responsible for maintaining. This would include those heads that are serviced by cities or utility companies under contract with the State.

Standards (Columns 26-28)

The number of light standards that the MDOH has the responsibility of maintaining.

Traffic Signals (Columns 29-30)

This field is used to record the number of traffic signals that the State is responsible for maintaining. Those signals maintained by cities under contract to the State should be coded as well.

Flashers & Beacons (Columns 31-32)

The number of flashers or beacons along the segment of highway that are the maintenance responsibility of the MDOH.

Signs - Type (Column 33)

This column is used to designate the type of sign that is being maintained within the segment. They are divided according to the number or type of support holding the sign.

D - Delineators and Milepost Markers
S - Sign Supported By One Post (Single)
M - Sign Supported By More Than One Post (Multiple)
O - Overhead Signs

Sign - Count (Columns 34-36)

This field is used to record the number of signs for each of the sign types D, S and M and the number of sign panels for overhead signs.

Overhead Sign Structures (Columns 37)

The number of overhead sign structures that are the responsibility of the MDOH.

Crash Barriers - Type (Column 38)

This column is used to code the type of crash barrier maintained by the State. They include,

B - Plastic Barrels filled with sand
T - Plastic Tubes filled with a liquid
G - Energy Absorbing Guardrail

Crash Barriers - Count (Colunn 39)

This field is used to record the number of locations of each of the types of crash barrier within the inventoried segment.

Raised Pavement Markers (Columns 40-42)

The number of raised type of pavement markers used to delineate lanes, edge of road, gore areas, etc., within the jurisdiction of the MDOH.

Pavement Messages (Columns 43-47)

This field is used to code in the number of square feet of messages placed in the road surface. These include actual messages, symbols, stop bars, crosswalks, etc., other than edge or centerline striping. Appendix C provides a table of the amount of area within common symbols and messages.

Landscaped Area (Columns 48-49)

These columns are used to record the number of acres to the nearest 1/10 of an acre within the ROW where routine vegetation control involving hand mowing and seeding, chemical spraying, fertilization and seeding; irrigation; and tree and shrub planting, removal, trimming and spraying are required. This would include areas around interchanges, rest areas, and medians where landscaped.

INVENTORY LENGTH FORM

The second type of form is used to record certain roadway features that are measured in terms of length rather than by number. An example would be the miles of unpaved ditch within the segment of roadway being inventoried. To assist in the collection of this information an additional worksheet has been provided where beginning and ending locations according to the vehicles odometer of the different features can be recorded. This data can then be transferred to the actual input form. The following instructions are for the form used for input into the computer.

Milepost (Columns 8-10)

This area is used to code in the beginning milepost reference point.

End of Section (Column 11)

This is used in conjunction with the milepost field to note the reference point where a maintenance section ends. The closest 1/10 of a mile in which the section begins or ends is coded in Column 11.

Fences - Type (Column 12)

This column is used to record the type of fence along the ROW that is maintained by the Department. They include:

L - Chain Link
W - Woven Wire
C - Woven Wire - Barbed Wire Combination
B - Barbed Wire (3 to 5 strands)
S - Snow Fence
F - Wyoming Snow Fence

Fences - Length (Columns 13-15)

This field is used in conjunction with the previous field to record the length in miles (to the nearest 100th of a mile) of each of the different types of fences within the road segment.

Sidewalks, Paths, & Bikeways (Columns 16-18)

The number of miles (to the nearest 100th of a mile) maintained by the MDOH.

Enclosed Drainage Systems (Columns 19-23)

This field is used to record the number of linear feet of enclosed drainage systems or storm water systems maintained by MDOH. This would include those pipes that are used to interconnect catch basins, drop inlets, etc. and channel the run-off to city systems or natural stream or rivers.

Ditches - Unpaved (Columns 24-26)

These columns are used to code the miles (to the nearest 100th of a mile) of ditch at the toe of cut or fill with only natural growth or loose stone lining the ditch.

Ditches - Paved (Columns 27-29)

The number of miles (to the nearest 100th of a mile) of paved ditch maintained by the MDOH located at the toe of fill or cut outlined with concrete, asphalt or other held in place material.

Curb and Gutter (Columns 30-33)

This field is used to record the number of miles (to the nearest 100th of a mile) of curbs and gutters maintained by the state. (See "Urban Median" Columns 46-48).

Average ROW Width (Columns 33-36)

The average width of the ROW for a portion of the roadway segment to the nearest foot.

Average ROW - Length (Columns 37-39)

The length, in miles (to the nearest 100th of a mile), of the ROW that has the same width.

Rock Slide Area (Columns 40-42)

This field is used to record the length (to the nearest 100th of a mile) of a section of cut which is prone to rock slides as so marked with signs on the roadside.

Roadway Mowable Swaths (Columns 43-45)

These columns are used to code the number of swaths (0'-8' wide) which are to be mowed according to MDOH policy. The length is shown in miles (to the nearest 100th of a mile).

Urban Median (Columns 46-48)

The number of miles (to the nearest 100th of a mile) of median located in urban areas. Curb and gutter and pinned down curbs, either of which may border the median, are coded separately (Columns 30-33 and 49-51).

Pinned Down Curb (Columns 49-51)

This field is used to record the miles (to the nearest 100th of a mile) of pavement edge curb that is made using precast concrete sections of curbing pinned to the edge of the roadway. (See "Urban Median" Columns 46-48)

Guardrail - Type (Column 52)

This column is used to code the type of guardrail along the side or in the median of the road. The different types are coded as follows:

W - W-beam Guardrail
G - Cable Guardrail
C - C-beam Guardrail
J - New Jersey Barrier
B - Wood-beam Guardrail
P - Wood Posts Barrier

Guardrail - Length (Columns 53-55)

The length of the guardrail identified in the previous inventory item is recorded in these columns. The length is recorded in miles (to the nearest 100th of a mile).

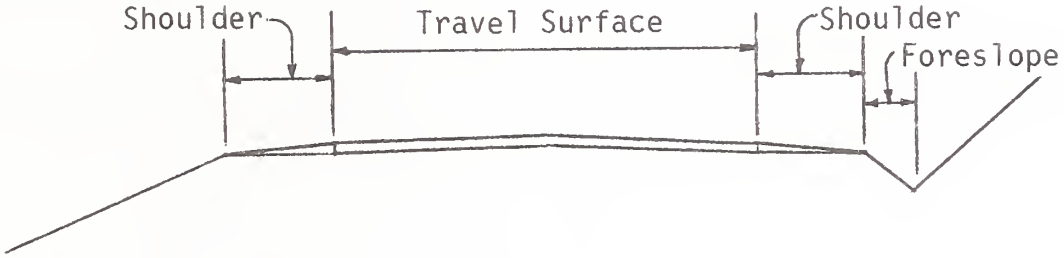
APPENDIX A
PHYSICAL INVENTORY ITEMS TO BE COLLECTED OR CHECKED IN THE FIELD

		Check	Collect
Road Mile	Mile	0	
Lanes	No.	0	
Travel Surface Width	Feet	0	
Travel Surface Type	Type	0	
Shoulder Length	Mile	0	
Shoulder - Width	Feet	0	
Shoulder - Type	Type	0	
Cattleguard	No.		0
Fences - Type	Type		0
Fences - Length	Mile		0
Rest Areas-Type	Type		0
Rest Areas-Count	No.		0
Landscaped Area	Acre		0
Litter Barrels	No.		0
Sidewalks, Bikeways & Paths	Mile		0
Pipes, Culverts & Small Bridges - Type	Type		0
Pipes, Culverts & Small Bridges - Count	No.		0
Enclosed Drainage System	Lin. Ft.		0
Drop Inlets	No.		0
Ditches - Unpaved	Mile		0
Ditches - Paved	Mile		0
Curbs & Gutters	Mile		0
Urban Median	Mile		0
Pinned Down Curbs	Mile		0
Rockslide Areas	Mile		0
Roadway Mowable Swaths	Mile		0
Average ROW - Width	Lin. Ft.		0
Average ROW - Length	Mile		0
Standards	No.		0
Luminaires	No.		0
Signals	No.		0
Flashers & Beacons	No.		0

		Check	Collect
Pavement Messages	Sq. Ft.		0
Raised Pavement Markers	No.		0
Signs-Type	Type		0
Signs-Count	No.		0
Overhead Sign Structures	No.		0
Crash Barriers-Type	Type		0
Crash Barriers-Count	No.		0
Guardrail-Type	Type		0
Guardrail-Length	Mile		0

APPENDIX B
Definition of Physical Inventory Item to be Collected in the Field

Road Cross Section



Travel Surface - That portion of the road cross-section marked for the traveling lanes. Can be from 18' to 24' in width.

Shoulder - The portion of the road between the travel surface and the foreslope. If this area is made up of several types of materials then the width of the highest type material would be the width of the shoulder. For example, if the distance for the edge of travelway to foreslope is 12' and the pavement extends 8' from the travelway with the remaining 4' grass, then the shoulder width would be 8'.

Avg. ROW Width - The average width of the ROW for the segment of road identified.

Cattleguard - The device installed in the road to keep cattle from the highway ROW.

Crash Barriers - Devices placed around bridge piers, railing gore areas, etc. to protect the motorist. Includes such devices as plastic barrels, plastic cells, energy absorbing guardrail, etc.

Curbs & Gutters - Devices used to channel run-off into drop inlets or catch basins in urban areas.

Ditches Paved - Those ditches that are parallel to the road and are usually found at the toe of cut or toe of fill and are generally lined with concrete or asphalt.

Ditches Unpaved - Those ditches that are parallel to the road and are usually found at the toe of cut or toe of fill. These would include only those that have a natural growth or loose stone lining.

Drop Inlets - Drainage devices which allow run-off to flow or access into enclosed drainage system. These include drop inlets, catch basins, manholes, etc.

Enclosed Drainage System - The series of pipes that make up an enclosed drainage system within an urban area. This would include those pipes that are used to interconnect catch basins, drop inlets, etc.

Fences - The type of fence maintained by MDOH (which includes chain link, woven wire, woven wire-barbed wire combination, barbed wire, snow fence and Wyoming snow fence)

Flashers & Beacons - Devices used to warn motorist of changes in road features (such as end of interstate road, sharp curves, etc.) or safety needs (school zones, intersection, signal ahead, etc.)

Guardrail - Devices used along the side of the road and in the median to protect the motorist from hazardous conditions. Several types are to be inventoried. These are:

- W-beam
- C-beam
- Wood Beam
- Cable
- New Jersey Barrier
- Wood Posts

Landscaped Area - Portion of ROW where routine vegetation control involves hand mowing and weeding; chemical spraying, fertilization and seeding; irrigation; and tree and shrub planting, removal, trimming and spraying. This would include areas around interchanges, rest areas and medians.

Litter Barrels - Barrels located along the side of the road for the convenience of the traveling public. The inventory would not include those barrels located within any rest area.

Luminaires - The light heads that are located within the ROW and maintained by the State.

Overhead Sign Structure - These are devices which support signs over the travel lanes and can be supported on both sides of the road (truss or wire) or cantilevered from one side.

Pavement Messages - Messages on the pavement surface used to advise motorist of required information. These include actual messages, symbols, stop bars, crosswalks, etc., but do not include centerline or edge striping.

Pipes, Culverts & Small Bridges - Devices used to carry water, people and animals under the road. For inventory purpose they are divided into four groups.

- Cross Culvert up thru 48"
- Cross Culvert over 48" to 10'
- Box Culverts (Small Bridges) 10' to 20'
- Side Pipes and Culverts

Raised Pavement Markers - Raised or flush delineators located on the pavement to delineate lanes, edge of road, gore areas, etc.

Rest Area - Area provided for the traveling public as a convenience which can be one of the following types:

- Rest area with modern flush type facitlites, picnic area, travel information
- Rest area with primitive type faciltiesa such as chemical toilets.
- Rest areas with no facilities such as scenic overlook and other turnouts.

Roadway Mowable Swaths - An area next to the road surface which is to be mowed. A swath can be up to 8' in width. If the area to be mowed is 8' to 16' then the area is considered as two mowable swaths.

Rock Slide Areas - Those areas in cuts which are unstable and which can slide or where loose rock can fall on the road surface.

Sidewalks, Bikeways & Parths - Pedestrian train or bike paths or walkways located within the ROW's and maintained by the State DOH.

Signals - The traffic signals including control boxes maintained by State forces.

Signs - Within the MMS Inventory these are grouped according to the number or type of sign support. The grouping is as follows:

- Delineators and Milepost Markers
- Single Sign Support
- Multiple Sign Support
- Overhead Signs

The number of signs on the supports for the first three groups is not captured.

Standards - The poles used to support luminaires.

Urban Median - Area used to separate opposing traffic in urban areas. They can be painted on the surface or raised using curb and gutters or pinned curbing.

APPENDIX C
STANDARD SIZES FOR PAINTED PAVEMENT MESSAGES

LETTERS	SQUARE FEET	LETTERS	SQUARE FEET
A	9	R	9
C	5	S	8
D	8	T	6
E	7	U	7
F	5	W	12
G	8	X	2
H	8	Y	5
I	3	0	12
K	7	2	13
L	4	3	13
N	8	4	13
O	9	5	13
P	9		

NOTE: ALL LETTERS AND NUMERALS HAVE 8 FOOT HEIGHT

RAILROAD X	53 Square Feet
STOP	32
AHEAD	41
LEFT	22
ONLY	26
TURN	30

11 Square Feet

7 Square Feet

8 Square Feet

PHYSICAL INVENTORY - COUNT

SHEET —— OF ——

ROUTE SYSTEM ______ ROUTE NUMBER ______ DIRECTION ______

DATE ______

1 2 6 7 50 55

MILEPOST	END OF SECTION	CATTLEGUARDS	REST AREAS		LITTER BARRELS	PIPES & CULVERTS		DROP INLETS	LUMINAIRES	STANDARDS	TRAFFIC SIGNALS	FLASHERS & BEACONS	SIGNS		OVERHEAD SIGN STRUCTURES	CRASH BARRIERS		RAISED PAVEMENT MARKERS	PAVEMENT MESSAGES (SQ.FT.)	LANDSCAPED AREA (ACRES)
			TYPE	COUNT		TYPE	COUNT						TYPE	COUNT		TYPE	COUNT			
6	11	12	14	15	16	18	19	21	23	26	29	31	33	34	37	38	39	40	43	46

OBSERVERS ______ ______ ______

PHYSICAL INVENTORY - LENGTH

SHEET ___ OF ___

ROUTE SYSTEM ___ ROUTE NUMBER ___ - DIRECTION ___

DATE ___

1 2 6 7 56 61

MILEPOST	END OF SECTION	FENCES		SIDEWALKS, PATHS & BIKEWAYS MILE (TO 1/100)	ENCLOSED DRAINAGE SYSTEM LIN. FT.	DITCHES		CURB & GUTTER MILE (TO 1/100)	AVERAGE ROW		ROCK SLIDE AREA MILE (TO 1/100)	ROADWAY MOWABLE SWATHS MILE (TO 1/100)	URBAN MEDIAN MILE (TO 1/100)	PINNED CURB MILE (TO 1/100)	GUARD RAIL	
		TYPE	MILE (TO 1/100)			UNPAVED MILE (TO 1/100)	PAVED MILE (TO 1/100)		WIDTH LIN.FT.	LENGTH MILE (TO 1/100)					TYPE	MILE (TO 1/100)
5	[illegible]	[illegible]	13	[illegible]	19	24	27	30	33	37	40	43	46	49	[illegible]	[illegible]

OBSERVERS ___________ ___________ ___________

PHYSICAL INVENTORY

WORKSHEET FOR LENGTHS

SHEET ---- OF ----

ROUTE SYSTEM ---- ROUTE NUMBER ---- DIRECTION N S E W
(CIRCLE ONE)

DATE ----

MILEPOST	FENCE MILES			SIDEWALKS BIKEWAYS & PATHS		ENCLOSED DRAINAGE SYSTEM		DITCHES				CURB & GUTTER		AVERAGE ROW WIDTH			ROCK SLIDE AREA		SWATH MILES		URBAN MEDIAN		PINNED CURB		GUARDRAIL			END OF SECTION
								UNPAVED		PAVED																		
		LOCATION		LOCATION		LOCATION		LOCATION		LOCATION		LOCATION			LOCATION		LOCATION		LOCATION		LOCATION		LOCATION			LOCATION		
	TYPE	BEGIN	END	BEGIN	END	BEGIN	END	BEGIN	END	BEGIN	END	BEGIN	END	WIDTH	BEGIN	END	BEGIN	END	BEGIN	END	BEGIN	END	BEGIN	END	TYPE	BEGIN	END	

OBSERVERS ---- ---- ----

December 2, 1981

ADDENDUM TO
MAINTENANCE MANAGEMENT SYSTEM
INSTRUCTIONS FOR PREPARATION OF THE ROADWAY INVENTORY

GENERAL

During the four meetings which were held in preparation for taking the roadway inventory, a number of questions were asked and clarifications requested. Items not originally considered came to light, and opportunities for causing confusion were brought out. As a result, this addendum has been prepared and should be used in conjunction with the document entitled "Roadway Inventory, Montana MMS, By BTML, Montana Department of Highways." Page references are to page numbers in that document.

1. Page 3-5. Under "Route System" add, "U for State Maintained Ways in Urban Areas not on the Primary System."

2. Page 3-5. Under "Route No." add to frontage road coding:

   A. All frontage roads will be associated with one of the interstate systems.

   B. Frontage roads that crisscross the interstate will be coded for the side of the road they begin on (lowest ref. point on mainline).

   C. Roads that just cross over (or under) the interstate will have the side coded as N for I-15 and W for I-90 and I-94.

   D. Cross overs (or under) that are spurs off of frontage roads will have their inventory data included as part of the frontage road data.

3. Page 3-5. Under "Route No." add:
   For local roads maintained by the state with no route number assigned, leave the route number space on the inventory sheets blank but write the

description and location of the road on the form. If milepost markers are available use them, but if not, use odometer distances and enter the miles in the milepost column and so note as a comment.

4. Page 3-6. Under "Milepost" note that the mileposts may or may not be a mile apart leaving distances lesser or greater than a mile. The Highway Information System (HIS) contains a computer program subroutine that compensates for this however, so all references must be to the mile posts. In urban areas where milepost markers are not available, use odometer distances to establish mile points and so note as a comment.

5. Page 3-7. Under "Rest Areas", note that items such as curbs, sidewalks or litter barrels in rest areas are not to be individually coded, but are simply part of a rest area. Include scale houses as "N-Rest Area with no facilities."

6. Page 3-7. Under "Pipes, Culverts and Small Bridge - Type" note or add the following:

    A. For elliptical pipes or pipe arches (squashed pipe) use the largest dimension to determine size classification.

    B. Add the code "I - Irrigation Pipes".

    C. Add the code "U - Underdrain Outlets."

7. Page 3-8. Under "Pipes, Culverts, and Small Bridges - Count" add the sentence:
In the case of underdrains, the count is to indicate the number of outlets, not the number of pipes.

8. Page 3-8. Under "Drop Inlets" add the sentence:
Drop inlets which are sumps with no outlets (dry wells) shall be included in the total but the number which are dry wells shall be so indicated on the reverse side of the form.

9. Page 3-8. Under "Flashers & Beacons" note the following:

   A. The number to be counted refers to the number of units not the number of individual bulbs which happens to make it up.

   B. If the unit consists of flashing light(s) and a sign they shall be counted separately.

10. Page 3-10. Under "Landscaped Area," delete the reference to "rest areas." See item 5, above.

11. Page 3-11. Under "Fences - Type" add the following:

   A. Add the code "R-Rock Fence" for special heavy duty fence constructed to prevent stones from falling on the roadway.

   B. Add the code "X-Retaining Wall."

12. Page 3-11. Under "Fences - Length" add the following sentence: This field is also used to record the length of retaining walls if "X" is recorded in the previous field.

13. Page 3-12. Under "Curb and Gutter" note that bituminous curb is included in this item.

14. Page 3-13. Under "Guardrail - Type" note the following:

   A. So called "Flat Ribbon" guard rail is to be included under "C-C-beam Guardrail".

   B. No differentiation is made between concrete and wood posts so if indiviudal concrete posts are used to create a barrier they are to be coded under "P-Wood Posts Barrier".

15. Special Added Item: Record rip-rapped slopes on "Physical Inventory-Length" sheet by writing "R" in right hand margin at appropriate mile

marker followed by the length to the nearest 100th of a mile. Example: "R 0.75". If concrete filled, note as a comment on reverse side.

16. Special Added Item: Record number of Truck Safety Ramps and their location at top of Physical Inventory - Count sheet.

17. General Note: Since all items will be keypunched for use in a computer, the general rule of "right justification" should be used. That is, when ever entries are made utilizing a number of specific blocks, the right hand block should be filled. For example, December 9, 1981 would be coded 120981 and January 21, 1982 would be coded 012182. Where decimal points are provided on the form (see miles of fence on the Physical Inventory - Length sheet for example) they, of course, must be observed.

MR:cp:214X28

December 11, 1981

ADDENDUM 2
MAINTENANCE MANAGEMENT SYSTEM
INSTRUCTIONS FOR PREPARATION OF THE ROADWAY INVENTORY

The following additions should be made to the procedures outlined in the "Roadway Inventory, Montana MMS by BTML, Montana Department of Highways."

1. Page 3-7. Under "Pipes, Culverts and Small Bridges - Type" add the following:
    a. Add the code "P - Underpass pump station locations." (Code the number of pump station locations within the mile, not the number of pumps at the location.)
    B. Add the code "X - Irrigation Pumps" (Code the number of irrigation pumps located within the mile used to irrigate landscaped areas.)

MR/cp/214X29

PLAN

BUDGET AND WORK PROGRAM SUBSYSTEM DEVELOPMENT

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 4

November, 1981

PLAN
BUDGET AND WORK PROGRAM SUBSYSTEM DEVELOPMENT

INTRODUCTION

The historical method of developing budgets in the Montana Department of Highways has been through the use of the conventional line item system. In this method all costs are listed that are associated with various functions such as personal services, employee benefits, supplies and materials, and so on. No indication of the benefits, however, which are expected to be obtained as a result of budgeted expenditures are given. Line item budgeting does provide fiscal control, but strictly from an accounting standpoint as expenditures are made and coded, and comparisons are made with budgeted funds. Two separate systems for line item budgeting have been in use in the MDOH. The first is the system developed within the Department, and the second is the Statewide Budgeting and Accounting System known as SBAS. At the present time the Montana Department of Highways is under a mandate to use SBAS. From the development of a management system viewpoint, the most significant difference between the MDOH System and SBAS is the way in which fringe benefits are managed. The differences occur in both the leave type of fringes as well as the employee protection type (worker's compensation, retirement, unemployment protection, etc). In the MDOH system fringes are calculated as a percentage add-on on labor and in SBAS fringes are separate line items.

As part of the total development of the Maintenance Management System (MMS) for the MDOH, performance budgeting is being introduced. In this method, funds are budgeted on the basis of what will be gained as a result of the expenditure of the budgeted funds. To make this possible, work is divided into logical parts called "Activities." The work required to perform activities is in terms of labor, equipment usage, and material with the method of doing the work shown on a document entitled "Activity Description and Accomplishment Method" (ADAM). When costs are related to these factors and frequency of needed work is established, a performance budget can be developed. The performance budget accounts for varying needs and rates of deterioration, both as regards different geographic areas and the various activities.

The budget will be submitted in SBAS format in accordance with Montana law supplemented by a Performance/SBAS matrix budget of broad groups of line items (i.e., Personal Services, Employee Benefits, Materials and Supplies, etc.). The total budget document will therefore include the advantages of the performance budget and will also furnish needed fiscal control as both line items and performance budgets will be given. The detailed breakdown of these groups will be shown in line format only as little would be gained in attempting to matrix performance budget items with an elaborate detailed line item budget. There would simply be too many items to reasonably predict.

Since the matrix will be in Performance/SBAS format only, other provisions will be made to supply information on which to base management decisions involving total cost of specific activities. It will be in general conformance with current MDOH accounting system practice and the information will be readily available so it may be furnished on an "as requested basis." To do this, separate programs or sub-routines of larger programs will be developed to account for fringe benefit costs and other indirect costs which may be germane for particular applications.

GENERAL

The budgeting process is presented graphically in Figure I and is divided into four phases as follows:

- Phase I - Preliminary Budget Actions.
- Phase II - Preliminary Performance Budget Preparation.
- Phase III - Final Recommended Line Item/Performance Budget-Executive, Legislative Action.
- Phase IV - Final Approved Working Budget Preparation.

The process illustrated in Figure I is somewhat idealized to present the major concepts of the development. It does show the orderly progression of events which must occur during the process. It should be noted specifically that there are two major "Yes - No" decision points shown, but there will be others as well. The budgeting process is essentially a trial and error system as there are innumerable variables. There are a great number of policy options derived from combinations of various service levels, emphasis or de-emphasis of specific activities, work which will be done as betterments or special maintenance projects, and so on. There are, therefore, a number of budget options which correspond to the various policy options. The design of

the budgeting system will permit management to explore many possibilities in order to obtain the most benefit from funds spent and to select the best compromise.

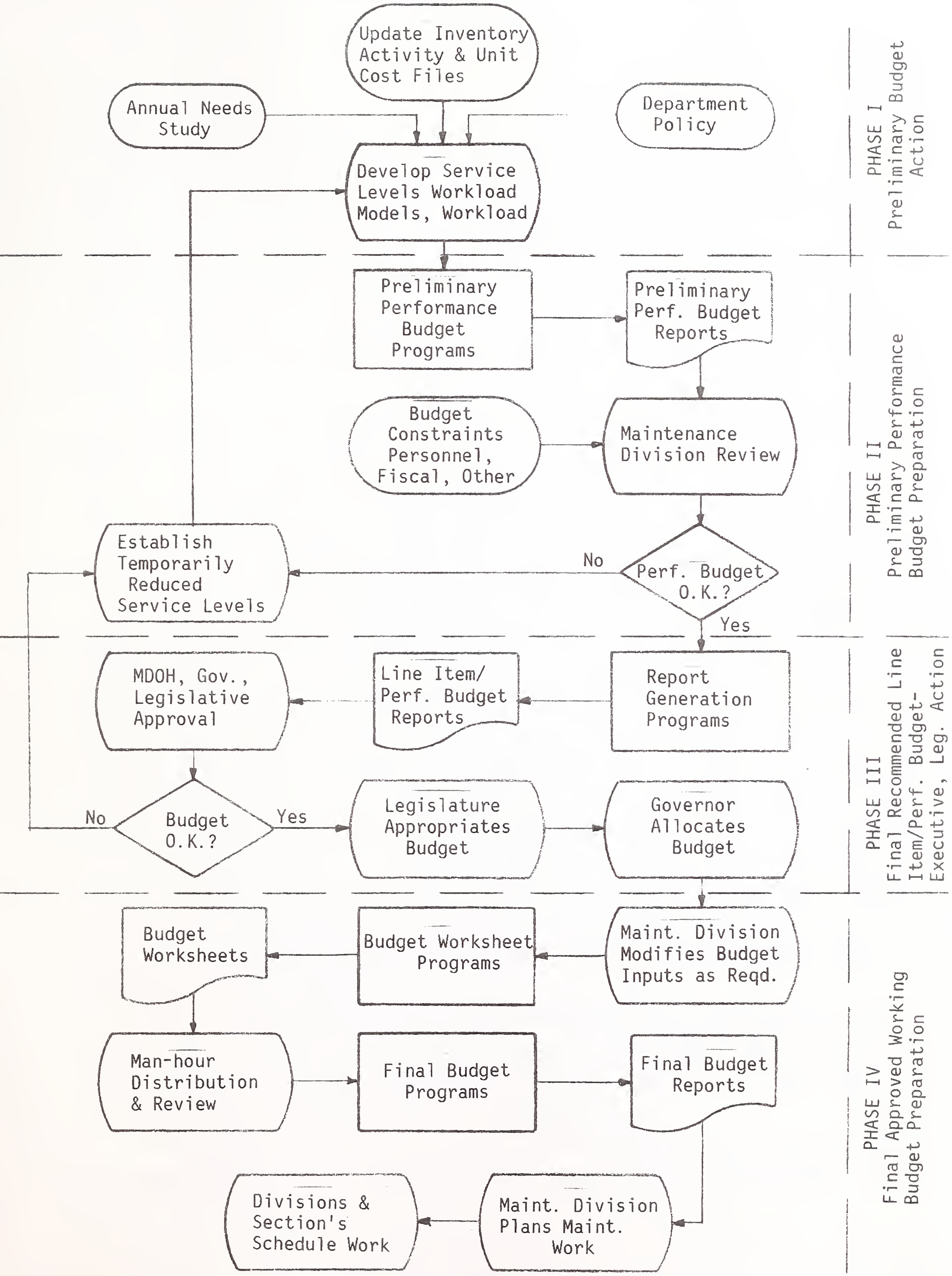

Update Inventory Activity & Unit Cost Files
Annual Needs Study
Department Policy
Develop Service Levels Workload Models, Workload
PHASE I Preliminary Budget Action
Preliminary Performance Budget Programs
Preliminary Perf. Budget Reports
Budget Constraints Personnel, Fiscal, Other
Maintenance Division Review
Establish Temporarily Reduced Service Levels
No
Perf. Budget O.K.?
Yes
PHASE II Preliminary Performance Budget Preparation
MDOH, Gov., Legislative Approval
Line Item/ Perf. Budget Reports
Report Generation Programs
No
Budget O.K.?
Yes
Legislature Appropriates Budget
Governor Allocates Budget
PHASE III Final Recommended Line Item/Perf. Budget-Executive, Leg. Action
Budget Worksheets
Budget Worksheet Programs
Maint. Division Modifies Budget Inputs as Reqd.
Man-hour Distribution & Review
Final Budget Programs
Final Budget Reports
Divisions & Section's Schedule Work
Maint. Division Plans Maint. Work
PHASE IV Final Approved Working Budget Preparation

FIGURE 1 BIENNIAL BUDGETING CYCLE

PHASE I - Preliminary Budget Activity

A performance budget requires a substantial amount of information, and answers must be developed for the following questions before proceeding. What are all the facilities which are going to be maintained? What is the cost of everything that is going to be used in connection with the maintenance activities? What is the condition of the facilities to be maintained, both predicted for the future and at the present time? How well should items be maintained; and, conversely, how far should they be allowed to deteriorate before anything is done?

This phase of the budget process is to answer these questions specifically by carrying out the following functions:

- Update Inventory, Activity and Unit Cost Files
- Obtain Results from Annual Needs Study
- Evaluate Changes in Department Policy
- Adjust Service Levels, Workload Models, and Workload

For the initial performance budget, the inventory will be developed as part of the Maintenance Management System project. The total inventory is actually made-up of three types. The first is a physical inventory which concerns the "physical" characteristics and descriptions of the road system itself. Some information for this is contained in currently available files, and some will have to be obtained by direct measurement in the field. The information obtained in the field is to be collected by trained crews and placed in computer files. The physical inventory must be updated at least biennially in the future, or preferably even on a continual basis for some items. To facilitate this procedure, final construction or betterment project documentation should neither be accepted nor considered complete unless it contains a completed "Construction/Betterment Project Inventory Update Form" developed as part of the MMS.

The second type is a traffic inventory which effects maintenance and will be taken from currently available information. In the future, the inventory concerning traffic will be updated automatically from the Traffic Counting Subsystem of the Highway Information System (HIS).

The third type of inventory concerns the environment or the climate which will effect the conditions under which the highway system is maintained. This

includes amount of precipitation, number of storms, inches of snowfall, geographic characteristics and so on. This will be obtained from a combination of information from the central office and the field maintenance bureaus. This information tends to be relatively static in nature although periodic review is useful. The success of the entire inventory process is contingent upon a joint effort of the Field Maintenance Bureaus and the Maintenance Division in Helena.

Activities also require a pre-budget preparation review as they define all elements of the work which is to be budgeted for including measurement units. While activities tend to remain relatively unchanged, technological advances are made, and experience can show a need to disgard, replace or alter activities. The apparent appearance of constancy is deceptive, and review of activities must be done before using them in the budget development process.

Unit cost files must also be updated. These are the costs which contribute to the total cost of performing activities; labor, equipment and materials. Current costs must be used with great care and often serve as only a starting point. They are only useful for estimating the cost of performing activities at the time of preparation. For budgeting purposes, unit costs must reflect those costs that are anticipated to be in effect for the budget year.

The results of the Needs Study must also be considered in this phase. They will show a comparison of actual conditions with desired conditions and can locate areas of specific problems. In addition, locations where special projects or betterment projects are required or suggested can be indicated. A Needs Study is primarily a Field Maintenance Bureau function and is to be done jointly by the Bureau Chief and Superintendent. The information from the Needs Study is then forwarded to the Maintenance Division in Helena for incorporation in the pre-budget documents.

Department policies or policy changes which would affect the Maintenance effort must be accounted for during this phase. Department policy may, for example, indicate a concentration on certain activities. Additionally, a change in material or methods may also be a matter of policy. As an example, there might be some minimum percentage of emulsion required as compared with road oil; guardrail types or materials might be changed; a type of aggregate might be banned and so on. A proliferation of certain types of lawsuits could cause policy changes as well.

An adjustment in service levels must also be considered at this point in the process. A service level is the level to which a maintainable item is to be maintained. A change in the Departmental policy could cause such changes; but environmental considerations, changes in availability in the kinds of material, and a known reduction in funds among other items could also require changes. Service levels should be those which are anticipated to be in force during the budget year. There is little value to a budget which appears to promise a level of service which cannot be provided.

A change will then be made in workload models if indicated. Past experience should show whether projected models (or formulas) to establish levels of effort for an activity have been reasonable and appropriate. For the first performance budget, the models will be simple and basic and undoubtedly become more sophisticated in succeeding years. A typical example of a basic model is the formula:

$WL = I \times R$ where;

WL - Workload from an activity expressed in work units.
I - Quantity of fiscal inventory unit.
R - Workload Rate expressed in work units per inventory unit per year.

The workload, or the total amount of work to be done, is the last item within this phase which should be considered. It is developed from the inventory and workload models.

In summary, the items contained in Preliminary Budget Activities are the foundation upon which the budget is to be constructed. Attempts to produce accuracy in any succeeding steps would be of little consequence unless the initial steps in this phase are done properly and with great care. Phase I is a joint effort of both headquarters and field personnel. The emphasis is on what, how, cost of work to be done and results to be gained, not on how much was budgeted or expended in previous years on salaries, fringe benefits, expenses or similar and allied line items.

PHASE II - Preliminary Performance Budget Preparation

An idealized schematic diagram of this process is shown in Figure 2 which serves to define the key elements which make-up the total process. Figure 3 further delineates one of the elements, workload, and its make-up. This is presented in this manner to reinforce the point that last years undone work

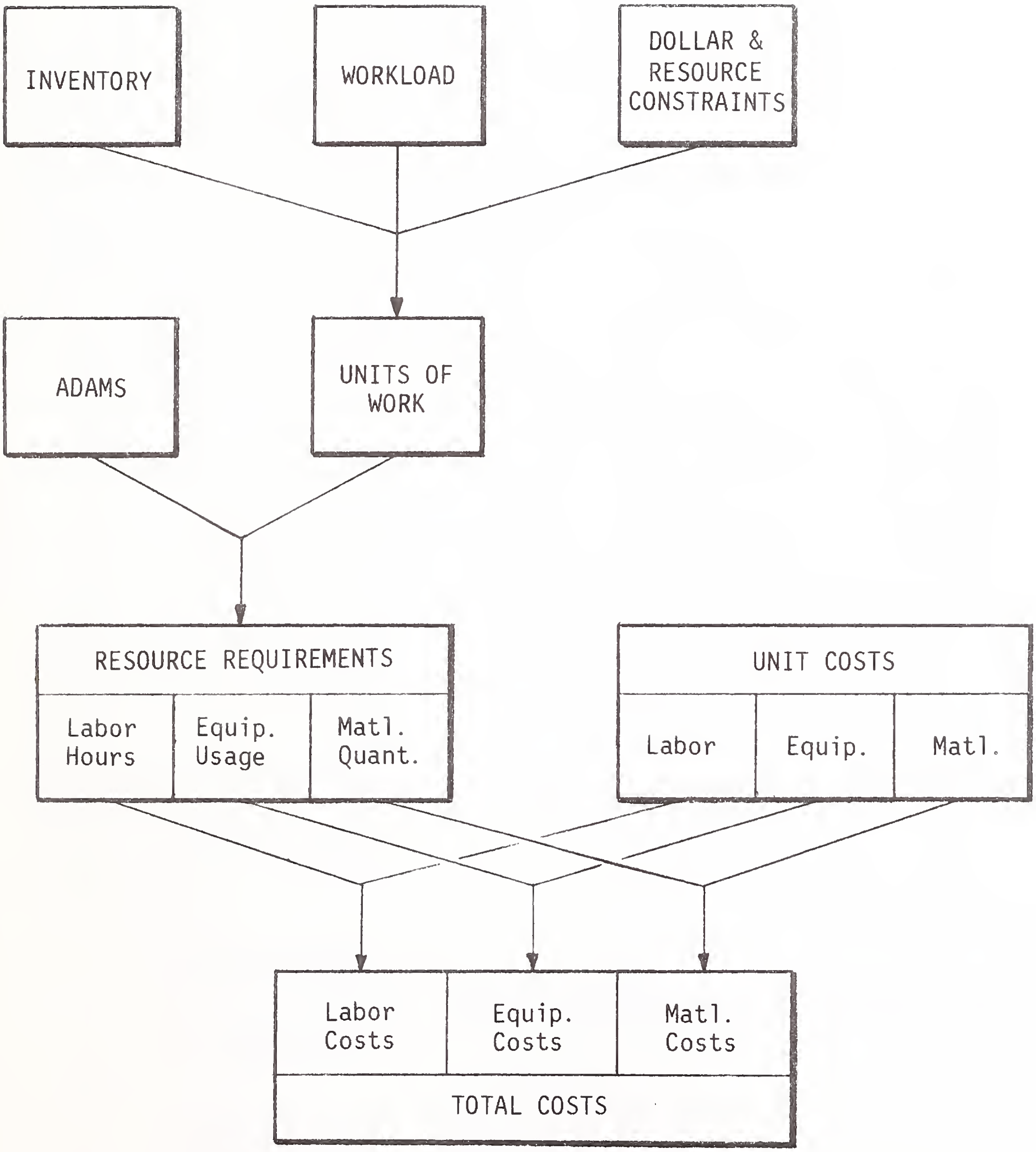


FIGURE 2 PERFORMANCE BUDGET PROCESS

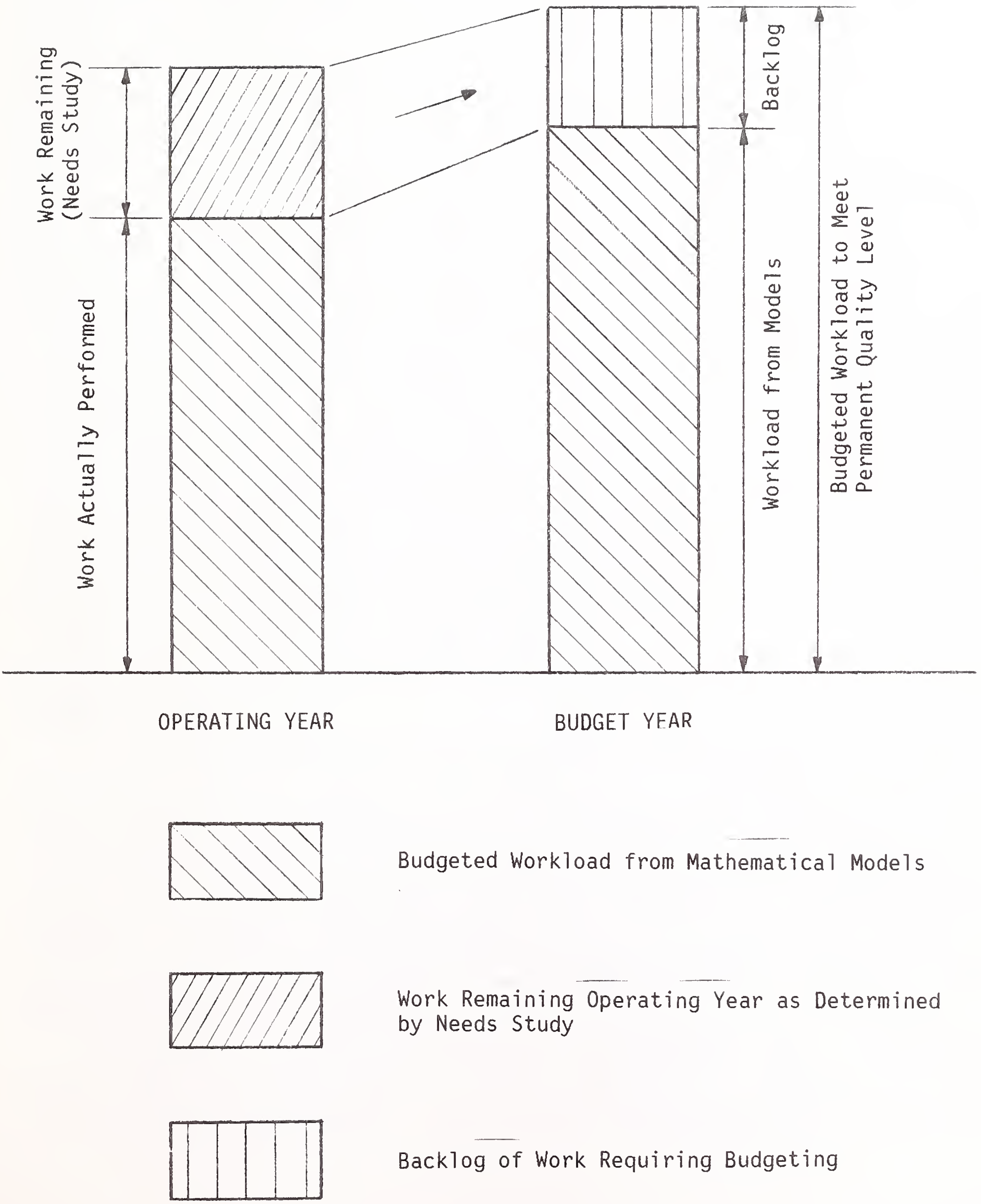

Work Remaining
(Needs Study)
Work Actually Performed
Backlog
Workload from Models
Budgeted Workload to Meet
Permanent Quality Level
OPERATING YEAR
BUDGET YEAR
Budgeted Workload from Mathematical Models
Work Remaining Operating Year as Determined by Needs Study
Backlog of Work Requiring Budgeting

FIGURE 3 WORKLOAD DEVELOPMENT AND ADJUSTMENTS

cannot be forgotten, but must be budgeted or otherwise accounted for in the future. In the first step of preparing the Preliminary Performance Budget, computer programs are run using the input updated during Phase I. The Preliminary Performance Budget Reports are produced and will show the costs of all activities, on an activity by activity basis. Labor, materials and equipment will all be shown for each. Labor will include 100% of the time of Field Maintenance Supervisors (Sectionmen) and working crew personnel, but the salary cost of higher positions will not be shown as that is considered an administrative cost. The total costs of all activities will represent all costs which can be considered on an activity basis. There will, however, be other costs to make-up the total Maintenance budget which will be expressed generally on a line item basis. There would be no particular advantage in attempting to spread them across the many activities in the performance budget as it would have little or no affect on the picture presented. These are contingent items which will be calculated, at least on a preliminary basis, as a percentage and will include all of the fringe benefits, both the leave and employee protection type. Also included would be other costs which would remain essentially the same - utilities, rental, administrative salaries, office supplies and so on. A third element which would be included essentially as a line item would be special projects to be paid from maintenance funds developed as part of the Needs Study whose budgeted costs are essentially subtracted from the funds that would be made available for performance budgeted items.

Following the initial preparation, the Maintenance Division will make a detailed review of the results. The first trial will be compared with available funding and the Maintenance Division will add specific constraints if, as is expected, the initial run exceeds some established criteria either fiscal or personnel. If the review indicates that an adjustment is required due to financial limitations, personnel limitations or other factors, the service levels will be temporarily reduced for selected activities, workloads will be adjusted and the cycle repeated.

The iterative process is a feature of the budgeting system. Undoubtedly it will have to be run a number of times in order to try different combinations of service level modifications. Consultations should be conducted with Field

Maintenance Bureau Chiefs at this point in the process. After the Maintenance Division is satisfied with the budget, Phase 3 is initiated.

PHASE III - Final Recommended Line Item/Performance Budget - Executive, Legislative Action.

This phase is initiated by running report generation programs and producing the resulting reports. The presentation will be in both line item and performance budget format. The reports will be submitted for approval to the offices of the Director MDOH and then to the Governor and Legislative Committees in conformance with the State's standard practice.

If the initial submission of the budget is not approved, it will be returned to the Maintenance Division and service levels will be further adjusted. The entire preliminary budget process will then be recycled, and the process repeated as needed to meet requirements or criteria stated in the disapproval.

When approval is obtained, normal legislative procedures will be implemented. The Legislature will enact legislation to appropriate funds and send it to the Governor for approval. The Governor, in turn, will then approve the legislation and allocate funds to MDOH to initiate Phase IV of the budget process.

PHASE IV - Final Approved Working Budget Preparation

The Maintenance Division will modify computer inputs as required to meet criteria as established by final allocation of funds and approved by the Director of Highways. If necessary, programs developed for the Preliminary Performance Budget in Phase II will be rerun until the desired results are obtained.

Budget Worksheet Programs will then be run and budget worksheets developed as output. These will show performance budget allocations and line budget items as appropriate, in order to present a complete picture to the Field Divisions. Temporary service levels to be used with standards ADAMs will also be issued to be used for the budget years.

Manpower distribution will then be made on the basis of the requirements of the Performance Budget and reviewed against assigned levels. After necessary adjustments have been made, final budget programs will be run.

Final budget reports will be prepared as required to furnish sufficient information to both the Maintenance Division office in Helena and the Field Maintenance Bureaus. On the basis of the reports, the Maintenance Division will plan the actual budgeted work on a statewide basis for the biennium. The Field Maintenance Bureaus will plan work for the budget year and actual work will be scheduled in conjunction with the Field Maintenance Supervisors in order to perform the needed maintenance activities.

The plans developed by the Maintenance Division and Field Maintenance Bureaus, in combination with the work schedules, comprise the Work Plan to be followed. This, in turn, when combined with administrative costs and other items which will be considered on a line item basis only, will constitute the Highway Maintenance Program for the MDOH.

Following the implementation of the Highway Maintenance Program, costs will be tracked and reported on a continuing basis as part of the Management Information Subsystem of the MMS (See Management Information Subsystem Development). The collected costs will then be compared with budgeted amounts. If the comparison shows trends that indicate that corrections or modifications will be required in work plans, adjustments will be made by rerunning portions of the budgeting programs as needed. Initial development of the budgeting computer programs will be done with this possibility a consideration.

SUMMARY - TABLE I

The preceding is a relatively complex series of steps in the development of a budget and work program and constitutes a major subsystem of the Maintenance Management System. Each step is significant and must be done in the prescribed order. Transfer of information, system analysis and computer programming done in conjunction with this subsystem will also be contingent upon the orderly progression of steps and events. Table 1 shows the process in a summary manner and also will serve as a means of checking progress when the process commences. It also indicates the various organizations and individuals involved.

BUDGET DEVELOPMENT FLOW SUMMARY

TASKS			Organization Performing Task					
			Leg.	Gov. Office	DOH	Maint. Div.	Maint. Bur.	Maint. Supv.
Initialize the Budgeting System (Phase I)	Develop Base Information for Budget Preparation	Review and Update Budget Data Base				●	●	●
		Previous F.Y. Needs Survey, DOH Policy			●	●	●	●
Develop Maintenance Division Budget (Phase II)	Develop Trial Preliminary Performance Budget	Develop Total Maint. Needs and Cost				●		
		Review and Select Constraints			●	●		
	Produce Performance Budget and Line Item Budget Modified Due to Constraints	Produce Performance Budget Combinations Based on Constraints				●		
		Review and Select Trial Budget for Submittal				●		
Budget Approval and Appropriations (Phase III)	Review and Approve Budget Request	DOH review and Approval			●			
		Gov. review and Approval		●				
	Appropriate Line Item Budget	Legislative Approp. Line Item Dollars	●					
		Governor Approves Appropriation		●				
	Allocation of Line Item Dollars	Governor Distributes Allocation to Departments (DOH)		●				
		DOH Distributes to Divisions (Maint.)			●			
Develop Approved Maint. Division Budget and Schedule (Phase IV)	Produce the Approved Performance Budget Modified Using Allocated Line Item Budget	Analyze Line Item Allocation and Identify Constraints				●		
		Produce Performance Budget Combinations Based on Constraints				●		
		Review and Select Approved Budget				●		
	Plan and Schedule the Approved Performance Budget	Perform The Planning Process				●	●	
		Perform The Scheduling Process					●	●

DT/dk/25C

PLAN

MAINTENANCE MANAGEMENT USERS MANUAL

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 5

December 1981

PLAN
MAINTENANCE MANAGEMENT USERS MANUAL

INTRODUCTION

To insure consistent scheduling and reporting procedures a MMS Field Manual will be prepared and made available to field and headquarters personnel. The documentation of maintenance activities, equipment and material classes, Activity Descriptions and Accomplishment Methods (ADAM's), planning, scheduling and reporting procedures will be included. The Manual will be used as a guideline to answer questions that may arise during implementation.

MMS FIELD MANUAL

The Field Manual will be divided into the following sections:

Maintenance Activities - A listing of the various maintenance activities performed in Montana, including activity numbers and accomplishment units will be discussed. The activity coding methodology will be outlined to assist in the assignment of new activities numbers in the future.

Equipment Classes - Equipment will be grouped into classes containing equipment items which perform similar functions, have a similar capacity for doing work and which have relatively the same maintenance and operating characteristics. A listing will be prepared describing the types of units included in the class and examples given. This equipment class section will assist personnel in a class code assigning to new units of equipment.

Material Classification - Material quantities associated with roadway maintenance will be reported in the Maintenance Management System. Material classes will be developed together with units of measures and unit costs.

Location Definititon - Location coding will be outlined specifying the available types of location coding. Typical examples include: Roadway Spot Location, Roadway To-From Location, Rest Area Location and Garage Location.

Activity Description and Accomplishment Method - To assist field personnel in scheduling and reporting work completed, Activity Description and Accomplishment

Method (ADAM's) will be prepared for each of the maintenance activities. The following items will be included on the ADAM:

Activity Name
Work Units
Activity Number
Activity Description
Quality Guide
Average Accomplishment Rate
Daily Accomplishment
Recommended Crew Size
Recommended Equipment
Recommended Material
Accomplishment Method
Location and Activity Reporting
Special Instructions

Each of these items presented on the ADAM will be discussed in detail in the Manual.

Maintenance Work Input Form - The basis of the Maintenance Management System is a record of all work accomplished and resources required to perform this work. A Maintenance Work Input Form will be developed to record the following types of information:

Date
Section Performing Work
Activity Code
Location
Work Accomplished
Labor Hours
Equipment Class
Equipment Hours and/or Miles
Material Class
Material Quantity

To insure accurate reporting of work accomplished, the MMS Users Manual will outline proper recording procedures for each of these items.

The "Material Class" and "Material Quantity" refer to all those materials which are indicated for use on an ADAM. For example, if on the ADAM for Activity 7202, Application of De-icing Chemicals and/or Abrasives; Sand, Salt, and Sand-Salt mixtures are all shown under "Recommended Material" the instructions will indicate that the quantity of each material used is to be shown individually and not collectively.

Since 100 percent of the work done by field maintenance forces will be accounted for by Maintenance Activities, instructions will be included for collecting the work done under an activity or group of activities leading to an accounts receivable when required. This will be done by developing a numbering system for cost centers unique to the various divisions preferably year identified. An allowance will be made on the field reporting form for entry of a cost center.

Planning and Scheduling - Division monthly planning and section weekly scheduling procedures will be prepared along with a Montana seasonal schedule of activities to assist field personnel in determining a general planning framework for performing maintenance.

Physical Inventory Update - A statewide physical inventory of maintainable items will be completed during the development of the MMS. It will be necessary to continually update the physical inventory as both construction projects and maintenance betterment projects modify various maintainable items. An overview of the initial inventory will be presented and instructions concerning inventory update procedures will be discussed.

MMS Field Level Reports - Various output reports provide information to the field level personnel. Examples of these reports will be presented along with explanations of how each of the reports should be analyzed as well as possible actions to be taken.

Appendices - An appendices will be prepared which will include the following:

Glossary of Terms
Area, Volume and Weight Calculations
Conversion Factors
Application Rates

DH:cp:214P

PLAN

MMS AND MDOH ACCOUNTING SYSTEM INTERFACE

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 6

December 1981

PLAN
MMS AND MDOH ACCOUNTING SYSTEM INTERFACE

A review of the current status of the two line item accounting systems currently in use in the Department of Highways was conducted. The first is the MDOH Accounting System and the second is the Statewide Budgeting and Accounting System (SBAS). The Department of Highways is currently under a mandate to use SBAS and, as a result, budget presentations are done in this format. Additionally, the primary difference between the systems, in so far as the development of the Maintenance Management System is concerned, is the way in which fringe benefits are managed.

For these reasons, a discussion was held on November 10, 1981 with Messrs. Prebil, Salisbury, Swartz and Harris of the MDOH; and it was decided to interface the performance budget and expenditure reports of the Maintenance Management System with SBAS on a matrix basis and not with the MDOH system. Separate programs or sub-routines within larger programs as appropriate will be developed to account for fringe benefit costs and other indirect costs which may be germane for particular applications. They will be run on an "as requested basis" and will supply "dead end" information (i.e., information that will not be used as a source for any other programs or as a data base) to provide a means for making cost comparisons leading to informed management decisions. This procedure was outlined to Don Gruel, Administrator Maintenance Division to ascertain if it would meet his needs and it was found acceptable.

MR/cp/214L

PLAN

MMS AND SBAS INTERFACE

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 7

December 1981

PLAN

MMS AND SBAS INTERFACE

The Maintenance Management System is inherently performance based and therefore a performance budget is mandatory to its operation and control. Conversely, SBAS is a classical financially oriented system which uses the conventional object codes. The relationship of these two systems is discussed in "Plan, Budget and Work Program Subsystem Development" in this report. Additionally, the details of the interface are described in Define System Outputs of "Plan, Data Processing System Design", also of this report.

Essentially, the above calls for the performance budgeted activities to be presented in matrix format with the principal groups of SBAS (Personal Services, Employee Benefits, Materials and Supplies, etc.) in both budget and expenditure reports. The detailed breakdown of the groups will be shown in line format only.

MR/cp/214K

PLAN

MANAGEMENT INFORMATION SUBSYSTEM DEVELOPMENT

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 8

DECEMBER 1981

PLAN
MANAGEMENT INFORMATION SUBSYSTEM DEVELOPMENT

INTRODUCTION

Before identifying the type of information which needs to be produced in the Montana Maintenance Management System, the management tasks performed by the Montana Maintenance Division had to be determined. At the same time, the managers responsible for carrying out the management tasks also had to be identified and the actual tasks each manager performs determined. The final requirement was to identify the types of information that the managers would need to perform the identified management tasks.

MANAGEMENT TASKS

Due to the limited time available, and the similarity between State Highway Departments, a list of tasks requiring performance was developed using information gathered from other states and modified to fit the needs of Montana. These have been grouped into three types of tasks: control of the maintenance work and its associated costs, evaluation of the effectiveness and efficiency of the maintenance work, and monitoring of the budget and schedule to the actual accomplishments and costs. The control of the maintenance work will be accomplished through comparing and evaluating the adherence of actual operations to the scheduled work and costs, and the monitoring of resources utilized for the period. The evaluation of effectiveness and efficiency will be handled by the monitoring of productivity and unit costs, activity and location analysis for exceptional work, and the monitoring of resource utilization over the year. These indicators can also be compared to historical indicators of the maintenance efforts to determine long term trends. The subsystem also allows for the control of the expenditure of funds through actual and scheduled expenditures and for the rebudgeting and rescheduling if substantive changes occur in areas such as policy, available dollars, and work programs. Examples of such a change might be the witholding or release of contingency funds, change in snow removal policy or decisions to contract certain maintenance

activities. Table 1 shows the more detailed tasks and how they relate to the three general management tasks.

MANAGERS

As the tasks were being determined, the individuals or positions who have responsibility for performing the management tasks were also identified. The positions can be divided into two areas. These areas are central headquarters and bureau level. Within the central headquarters the positions include the Administrator Maintenance Division and MMS coordinator. The bureau level includes the Division Bureau Chief, Maintenance Superintendent and Supervisor. Figure 1 provides the organization responsible for the management tasks. In many cases the same task is being performed by several positions. This is due to the line type of organization within the division. For each higher level the volume of information increases greatly, leading to the need of exception type information on work performed. Table 1 shows the positions responsible for performing each of the management tasks.

INFORMATION REQUIREMENTS

The final part of the analysis was to determine the information requirements necessary to carry out each of the tasks identified. The information needs can be grouped into the areas of schedule information on units and cost, work accomplishment, costs both broken down by resource and total, resource usage, productivity both average and standard and activity unit cost. This core of information provides all the information necessary for performing the management tasks previously outlined. Table 1 shows the information requirements in detail and how they relate to the management tasks.

INFORMATION COLLECTION

The present method of collecting information for maintenance management is through the payroll and equipment systems. Under the new MIS most of the management information will come directly from MMS field reporting forms into

TABLE 1
MANAGEMENT INFORMATION REQUIREMENTS ANALYSIS

TASK			POSITION RESPONSIBLE FOR PERFORMING TASK					INFORMATION REQUIREMENTS												
			STATE ADMIN. MAINT. DIV	MMS COORD.	DIV. FIELD BUREAU CHIEF	MAINT. SUPERINTENDENT	MAINT. SUPERVISOR	SCHEDULED UNITS	SCHEDULED COST	ACTUAL UNITS	LABOR COST	EQUIPMENT COST	MATERIAL COST	TOTAL COST	LABOR HOURS	MATERIAL USAGE	EQUIPMENT USAGE	PRODUCTIVITY AVG.	PRODUCTIVITY STDS.	UNIT COST
CONTROL THE MAINTENANCE WORK ACCOMPLISHED AND ASSOCIATED COST	CHECK ADHERENCE TO SCHEDULED WORK BY ORGANIZATION AND ASSOCIATED WORK CREWS	COMPARE SCHEDULED UNITS TO UNITS ACCOMPLISHED	●	●	●	●	●	●	●	●	●	●	●	●						
		ANALYZE ACTIVITIES PERFORMED		●	●					●	●	●	●	●	●			●		●
		ANALYZE WORK PERFORMED BY LOCATION		●	●					●	●	●	●	●	●			●		●
	CHECK ADHERENCE TO SCHEDULED COST	COMPARE STATE AND DIVISION LABOR, EQUIP. AND MATL. SCHEDULED TO COST OF COMPLETED WORK		●	●	●		●	●	●	●	●	●	●						
		MONITOR COST OF CONTRACTURAL SERVICES		●	●			●	●	●				●						
	CHECK RESOURCE UTILIZATION	COMPARE LABOR HOURS AGAINST PREVIOUS MONTHS		●	●										●					
		REVIEW MATERIAL USAGE FOR FISCAL YEAR TO DATE	●	●	●											●				
		REVIEW EQUIPMENT USAGE FOR FISCAL YEAR TO DATE		●	●												●			
EVALUATE THE EFFECTIVENESS AND EFFICIENCY OF THE MAINTENANCE PROGRAM	DETERMINE UNIT ACCOMPLISHMENT RATES AND COST	COMPARE ACTUAL TO STANDARD PRODUCTIVITY	●	●	●										●		●	●		
		COMPARE ACTUAL TO STD. UNIT COST		●	●					●	●	●	●	●					●	●
	REVIEW MAINTENANCE PROGRAMS BY ACTY, ROAD CLASS AND LOCATION	ANALYZE WORK ACCOMP. AND COST BY ACTIVITY	●	●	●			●	●	●	●	●	●	●	●			●		●
		ANALYZE WORK ACCOMP. & COST BY ROAD CLASS & LOCATION		●	●					●	●	●	●	●	●			●		●
	REVIEW FISCAL YEAR RESOURCE UTILIZATION	COMPARE LABOR HOURS AGAINST PREVIOUS MONTHS FOR F.Y.	●	●	●										●					
		REVIEW MATERIAL PROCUREMENT FOR THE FISCAL YEAR	●	●	●								●			●				
		REVIEW EQUIPMENT USAGE FOR THE FISCAL YEAR	●	●	●							●					●			
MONITOR THE BUDGET AND SCHEDULE VS. ACTUAL ACCOMPLISHMENTS AND COSTS	CONTROL THE EXPENDITURE OF FUNDS	MONITOR THE BALANCES OF SCHEDULED AND ACTUAL EXPENDITURES		●	●			●	●	●	●	●	●	●						
	REVIEW THE NEED TO REBUDGET AND/OR RESCHEDULE	RESCHEDULE IF NEEDS INDICATE		●	●					●				●						
		REBUDGET IF NEEDS INDICATE *				●	●	●	●	●	●									

*REBUDGETING WOULD BE PERFORMED IN THE PERFORMANCE BUDGETING SUBSYSTEM

DT/dk/25H

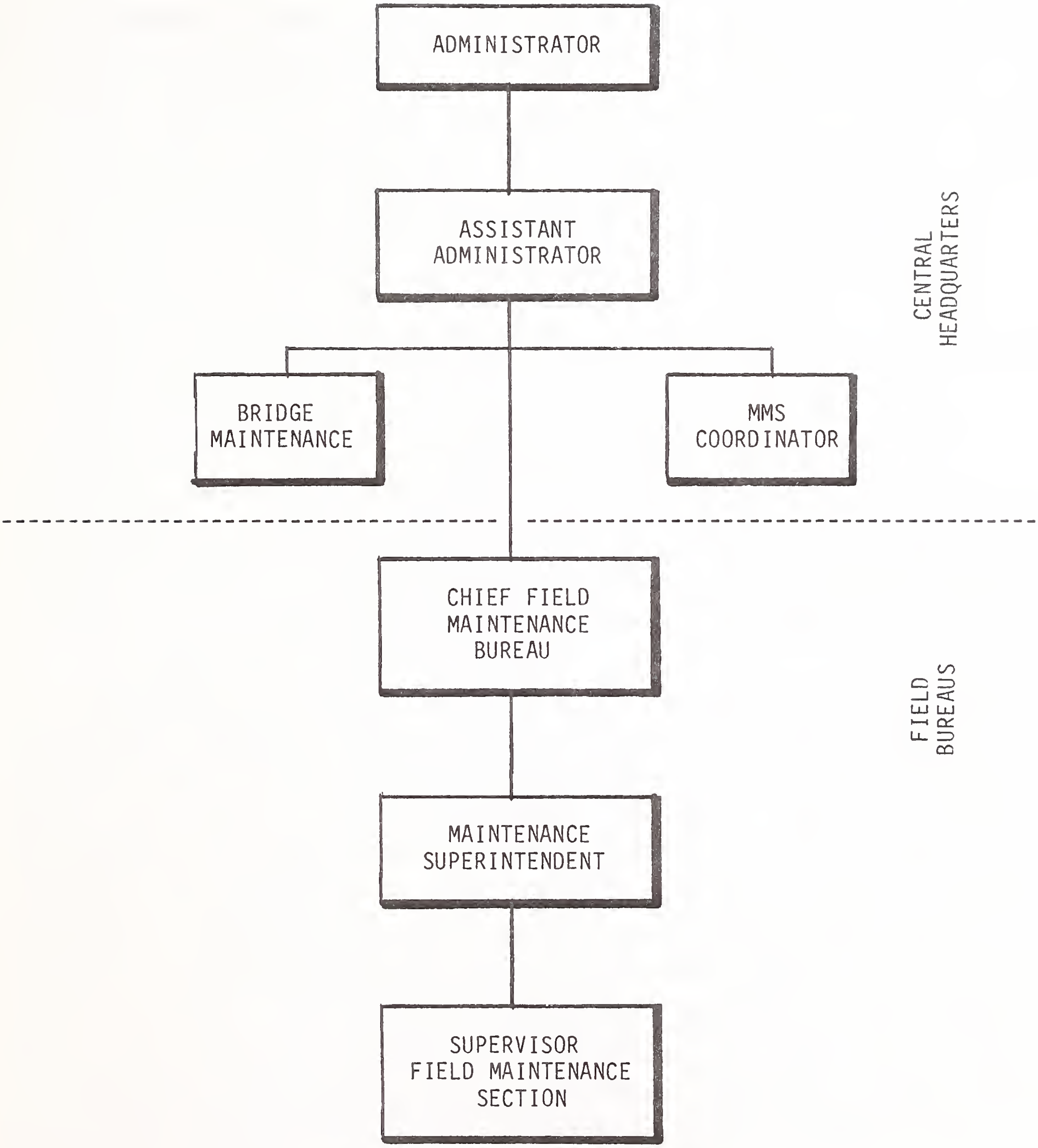


FIGURE 1 MAINTENANCE DIVISION MANAGEMENT ORGANIZATION

the Management Information Subsystem. Some information will still come from the payroll and equipment sources, although it will be somewhat different in nature. The Payroll and Equipment Systems will be modified to collect only the data they need to perform their primary function and pass only limited cost and use information to the MIS. The MIS field reporting form will collect information on the activities performed such as location, resources used, quantity of work performed, etc. The Management Information Subsystem will then combine the costs from the Payroll and Equipment Systems with MIS activity information to provide the Management information required to provide management with the data to perform their tasks. The type of information which each of the Systems (Equipment, Payroll, MIS) will collect and pass to the other systems is shown on figure 2. In the case of contract maintenance work, only the quantity of work performed and the cost will be entered on the field reporting form. Breakdown of resources will not be given and consequently the required transfer of internal information will be substantially abbreviated. Additional information such as scheduled work and cost, material unit costs, etc. will come from files within the MMS.

An example of the data collected by Payroll and how it would relate to Maintenance information needs is shown in figure 3. The Payroll system would pass the number of hours reported for the section crew along with the total payroll cost for the crew to the Management Information System. The MIS would then compute an average cost per hour for the crew and extend the labor hours reported for each activity to the MIS to obtain labor costs for each of the activities. Additionally, edits would be run to insure that labor hours reported for the two systems are equal and labor cost totals for each of the systems are equal. The interface between the Equipment System and MIS would be similar in that just the rental rates (both usage and ownership) would be provided the MIS for extending costs. In addition, edit checks would be made on equipment usage to see that the information on usage collected by both systems is consistent.

INFORMATION FLOW

A general flow of how the information would pass from the field reporting to the MIS reports is shown on Figure 4. The figure shows how information flows from the maintenance work section through edits to the different systems. Following this step the Management Information Programs then combine the different sources of information, including data from the ADAM's, material unit cost files and the other system information, to produce the core management

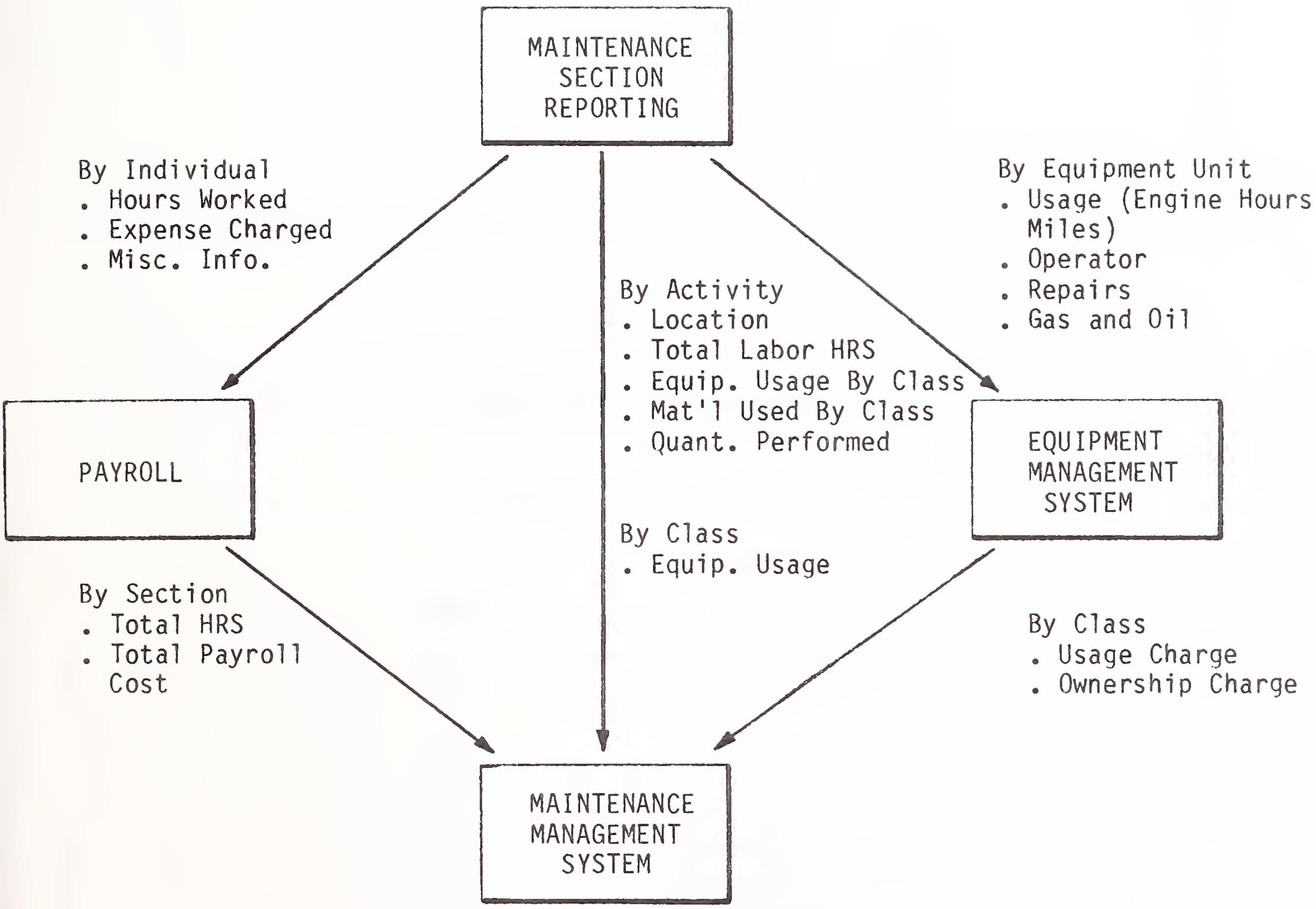


FIGURE 2 INFORMATION FLOW BETWEEN MAINTENANCE, EQUIPMENT AND PAYROLL SYSTEMS

PAYROLL SYSTEM

INDIVIDUALS	HOURS	LABOR COST
A	80	
B	80	
C	80	
D	80	
E	80	
	400*	$4,000

MANAGEMENT INFORMATION SUBSYSTEM

AVERAGE COST PER HOUR $\frac{\$\ 10}{400/\$4{,}000}$

ACTIVITY	LABOR HOURS	AVERAGE LABOR COST FROM PAYROLL	LABOR COST
1	60	x 10	600
2	80	x 10	800
3	120	x 10	1,200
4	35	x 10	350
5	45	x 10	450
6	60	x 10	600
	400		$4,000

*Check to see that hours reported in payroll equals hours reported in management information subsystem.

FIGURE 3 EXAMPLE OF RELATIONSHIP BETWEEN MAINTENANCE AND PAYROLL SYSTEMS

DT:dj:cp:214D

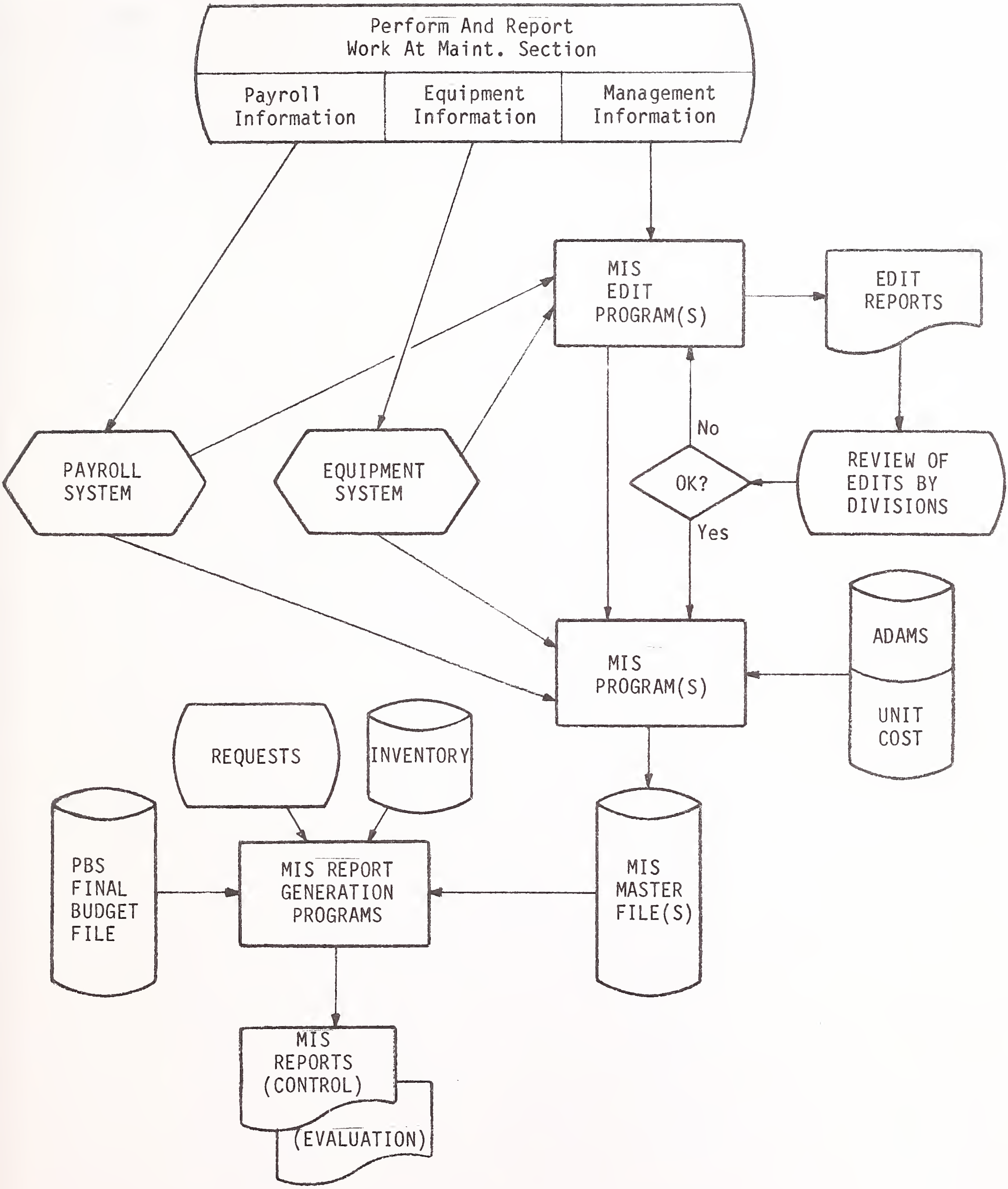


FIGURE 4 GENERAL INFORMATION FLOW IN MANAGEMENT INFORMATION SUBSYSTEM

information. This information is then placed into one or more MIS master files for use in producing the system reports. These system reports are produced by combining the MIS master files with other information such as the highway inventory or final budget files to produce standard reports or, where appropriate, request reports.

DT:cp:214D

PLAN

EQUIPMENT SHOP SCHEDULING AND REPORTING

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 9

December 1981

12/19/81

PLAN
EQUIPMENT SHOP SCHEDULING AND REPORTING

INTRODUCTION

Shop scheduling and preventive maintenance (PM) procedures were reviewed in three MDOH divisions. Techniques used to capture needed data and management procedures used by each activity engaged in scheduling were determined and PM lines of authority and lateral relationships were noted. Similarities or variations in procedures or management techniques by the various management and organizational levels were observed. From this review, observations on the apparent operational procedures are discussed. Following the discussion, recommendations for improving management and/or operational efficiencies are presented for consideration by MDOH.

GENERAL

This review of MDOH shop activities has led to the general observation that Task 1.9 must be expanded to discuss not only information on shop scheduling and PM activities, but related activities, organization interfaces, responsibilities, and duties of all personnel involved in equipment maintenance. For example, interrelationships of actions among shop, highway, maintenance and parts personnel as well as interface with the office business manager affects equipment management operational efficiency.

Another observation that requires expansion is preventive maintenance. As practiced by MDOH, PM is an activity that is performed each 20,000 miles. However, as generally interpreted, PM includes all servicing, inspections and other related preventive maintenance activities. Therefore, the discussion and analysis of this function will address all three MDOH preventive maintenance activities.

The subject of delineating and obtaining data on the various type of work performed on equipment requires expansion. While MDOH identifies shop work as repairs, PM, and road calls, other types of work that should be captured and identified are scheduled and unscheduled repairs, accident repair, warranty work and make ready activities of new equipment and preparation for disposal.

Costs for each of these separate activities should be identified, captured and summarized statewide and for each shop. All scheduling activities should ideally encompass each of these individual items.

MDOH has an excellent preventive maintenance program. However, costs for performing these activities are not identified and summarized as separate cost items. Ideally, the cost of all MDOH preventive maintenance programs should be captured to determine cost effectiveness of these programs. Similarly, a formal scheduling program should be established for each preventive maintenance activity.

Equipment downtime data is not being recorded by MDOH. In a true equipment management system, the cost and reasons for downtime can aid management in identifying those functions that can be improved to increase the efficiency of the equipment management operation. A common statement, however, was that an inordinate amount of downtime is caused by waiting for parts. A cursory inspection of parts rooms did reveal that an unusually small inventory of parts is maintained. When this fact is combined with the complex purchasing procedure that is required to obtain parts of any consequence, there is every reason to believe that the statement has considerable merit.

Field repair service procedures are well defined and are managed by the shop foreman. Costs for road service are captured and charged against the unit requiring repair. However, this activity is not identified on the shop order. Therefore, the amount of time expended, costs, number and type of road calls per unit of time by division or maintenance section cannot be defined.

With these initial comments to identify various techniques that would improve equipment management, an analysis of current MDOH operational and management activities follows. After this analysis, conclusions and recommendations, as necessary, are drawn based upon successful practices in similar operations.

OBSERVATIONS AND ANALYSIS OF CURRENT MDOH PRACTICES

Shop Workload Planning and Scheduling

The purpose of workload planning and scheduling is to increase shop efficiency by managing the amount of time required to repair equipment. Proper planning can decrease downtime by ensuring needed parts, proper personnel and

shop tools are available when a repair is scheduled into the shop. Proper planning can also minimize repairs by ensuring an adequate supply of parts are available for those items requiring "frequent" replacement.

Scheduled repairs other than PM is not a formal practice in the shops. Discussions with Bureau Chiefs and Shop Foremen indicate that the majority of equipment repairs are unscheduled. An effort was made to identify the percentage of shop time used for scheduled or unscheduled repairs, the various PM or servicing activities, make ready work, accident repair, and inspections. Since records of these various types of shop activities are not captured by MDOH personnel, the determination of the mix of these activities was not possible. Equipment management can be enhanced by identifying numbers and costs of these individual activities.

The 20,000 mile PM performed on all equipment is scheduled by the shop foreman, using an informal record to determine when individual units require PM.

Equipment servicing is performed by operational personnel. Scheduling for these activities is based on an hourly or mileage basis. Intervals for each servicing activity are stipulated by memorandum from the Equipment Division Headquarters, by equipment class.

Preventive Maintenance

In equipment management practice, PM, as usually defined, includes all actions taken by shop and operational personnel to reduce equipment maintenance by establishing various precautionary activities to lengthen equipment life. These include lubrication, oil and filter changes, checking all fluid levels, tune-ups, emmission control checks, inspection and rotation of tires, etc. MDOH has divided these activities into three identifiable functions: servicing, semi-annual inspections and PM. However, all are preventive maintenance activities.

As a general rule in MDOH, servicing is performed by the operator. Monitoring of servicing is not formalized and appears to vary from division to division. Forms to guide the operator and to record all servicing actions are available to each operator. In some cases, it would appear that the shop is

not aware if servicing has been performed by the operator. Since the operator reports to the highway maintenance function, the shop foreman has limited control over this operation. As a result, the efficiency of servicing depends upon a good personal relationship, which is always coincidental, rather than a formal organizational one.

Follow-up by the shop foreman appears to be weak, again depending on relationships between the shop foreman and maintenance section personnel. Proper servicing of equipment is a vital link in equipment maintenance procedures and must be of prime concern to all equipment management personnel.

MDOH has established a practice of conducting semi-annual inspections of each equipment unit. These inspections are scheduled and are usually conducted by shop foremen. The purpose of this inspection is to give shop management a condition report on units assigned to their jurisdiction. With the vast distances between maintenance section work areas and the division shop, it is possible that shop personnel might never see one of their units for months at a time. The semi-annual inspection gives shop personnel the opportunity to review service records, inspect a vehicle's condition and note items that need repair. Should the need for repairs exist prior to the next scheduled PM, the foreman will schedule the unit for repairs.

PM is an activity MDOH has developed to carefully and thoroughly check out each unit. Over 18 actions are identified to be performed and are listed on Form MP 91. These actions include: replacing plugs, points, condensor, filters, inspecting front wheel bearings, brake linings and drums, transfer case adjustments, replacing or inspecting windows, lights, windshield wipers, heater, tire wear, etc. The record of each item performed is recorded on the MP 90 Form and kept with the vehicle as part of its permanent record. Repairs and costs of PM are also recorded on the shop order form including a record of all parts used and shop labor expended. These shop orders are filed in the shop life history jacket and in the life history jacket maintained at the Equipment Division Office in Helena. Formal procedures for scheduling PM or for summarizing costs of PM performed during a year do not exist.

Field Repair

Field repair refers to action taken by shop personnel when equipment breaks down in the field and cannot be brought to the division garage for

repairs. Under these conditions the shop foreman dispatches a mechanic whose experience relates to the type repair required. The mechanic travels to the unit in the shop van or pickup carrying any special tools required as well as his own tools. Additionally, if possible, he will take the required part requiring replacement.

Generally, efforts are made to bring a unit requiring repair to the division garage. If this can't be done, it is transported on a low-bed trailer to the section garage.

When the mechanic makes a field repair, all costs (labor, travel, parts, etc.) are charged against the unit being repaired and becomes part of the unit's repair history. However, the shop order has no mechanism to permit management the capability of analyzing the number, type, and total costs of field repairs. This data should also be identifiable by division and by maintenance section.

Downtime Reporting

Downtime is defined as the time equipment is unavailable to the highway maintenance activity because the unit is under repair. Capturing downtime is a valuable management technique that can aid in identifing shop efficiency, equipment condition, parts mangement, garage, etc., capability and manpower needs.

Some highway agencies cost downtime and add it to the total life cost of the unit. Downtime can further be analyzed by identifying reasons for downtime. From this information, management has the ability to take action to correct the cause of lengthy downtime, i.e., downtime for parts, labor, bay space not available.

Currently, MDOH does not have the capability designed into its record system to collect this data. Revisions to the work order form can readily rectify this shortcoming.

RECOMMENDATIONS

Input documents require modification that would give the various levels of management information they require to: determine costs of various activi-

ties; determine the number and type repairs performed by class; identify reasons for units being in the shop; tabulate these reasons by class; capture downtime and analyze reasons for length of downtime.

The majority of the above information can be obtained by a redesign of the work order form by coding shop work activities into major groups and sub-groups, i.e., engine-major, tuning-subgroup, and by adding certain data to the top of the work order that will record downtime, reasons for downtime and reason vehicle requires attention (scheduled, unscheduled, accidents, servicing, P.M., inspection, make ready, warranty, etc.). An output report should be designed to assist shop personnel by identifying when each unit is due its next servicing, semi-annual inspection or P.M. The report should indicate mileage or hours of last action, current miles/hours; time and/or hours next action is scheduled and an indication of whether unit is overdue on an item. Exception reports should be prepared for Bureau Chiefs and Administrator of the Equipment Division showing only those units overdue.

Similar reports should be prepared showing the number by class and costs of each type of preventive maintenance activity. Reports should also indicate length of downtime by class, by unit, for each division, and lost income due to this downtime. Downtime analysis reports should also be prepared showing numbers of days vehicles have been down by time groupings, i.e., 1-5 days, 6-10 days, 10-20 days, over 20 days, with the reason identified. A report should be prepared that presents data recording all downtime by reason-down for parts, labor, bays, etc. A report should also be prepared giving total cost of the unit to date or year to date, and life to date, usage in hours or miles, and cost per hour or mile. Exception reports could be prepared for foremen and equipment managers and Bureau Chiefs listing those units that are 10-15% above or below costs. Action can then be taken on any of the above reports by various levels of management to understand or to investigate variants in fleet operations.

All parts ordered for specific units requiring repairs should be processed through the stores account system in the same manner as those purchased for inventory. The number used per year and the turnover rate can then be determined for all parts. This will permit the gradual upgrading of the parts system and the consequential reduction of downtime caused by lack of parts. The paperwork required to collect the data should not be allowed to delay the

parts acquisition and installation process. All computer oriented paperwork for these transactions can be posted after the fact without destroying the intent of the process in anyway.

Finally, cost data appears to be quite accurate and complete. However, this data is not being properly prepared in easily accessible report forms or exception reports for the various levels of management within the MDOH.

PLAN DEVELOPMENT

Details and timing of implementing the preceding recommendations are to a substantial degree beyond the control of BTML. They are, for the most part, contingent upon policy decisions which must be made in the Equipment Division and the way and rate at which the EMS is developed by state forces. Neither input forms nor output reports, for example, can be developed until a decision is made as to how much information is required and a commitment made to collect it. Documents to capture downtime cannot be developed until a decision is made as to a breakdown meaningful to the MDOH. Work order forms cannot be intelligently rewritten until decisions are made as to the groups and sub-groups of work activities which the MDOH considers desireable. Similar decisions must also be made in regard to preventive maintenance and parts management. When these decisions have been made, or at least defined so that they would be contingent upon actual form preparation, work will be initiated by BTML on the development of equipment repair shop scheduling and reporting procedures in conformance with the recommendations contained herein and Task 3.7 of the proposal.

During the preparation of the Maintenance Work Input Form, reviews will be made with Equipment Division personnel to insure compatability as to both content and timing with Equipment Reporting Forms. Preliminary discussions have all ready been held since new Equipment Reporting Forms are under development.

During the entire development process of the MMS, constant liason will be maintained with Equipment Division personnel whenever decisions are to be made which will impinge on equipment usage and recording. It is also assumed that the reverse will be the case for each step in the development of the EMS.

PLAN

TRAINING PROGRAM

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 10

December, 1981

PLAN
TRAINING PROGRAM

INTRODUCTION -

With the installation of a Maintenance Management System in Montana, maintenance activities will be managed in an entirely different manner. This will require that new training programs be developed and used. Many changes from the traditional method of measuring the accomplishment of tasks in the Montana Department of Highways are expected. A reluctance to change in any organization is to be anticipated. A well-developed and carefully planned training program will be implemented to overcome this reluctance. Scheduling of maintenance activities is a new concept and the advantages of the process will be underscored. Once the advantages of the MMS are clearly understood, changes can be introduced more easily.

Training occurs throughout the design and implementation of the Maintenance Management System and can be of either a formal or informal nature. The training activity can be as structured as a lecture for a specific group or as casual as an informative conversation with an individual encountered by chance. Whereas many employees at many levels will be effected, either directly or indirectly, a significant effort will be made in the area of training. The very success of the system necessitates a thorough understanding of the system and dictates that training be a continuous process.

GENERAL -

Initial orientation or training sessions have already been held to explain the correct procedure for the collection of inventory data. Four meetings were planned and conducted by BTML personnel and George Swartz, Maintenance Management System Project Coordinator. The meetings were held during late November and early December in Glendive, Missoula, Great Falls, and Bozeman. A total of 198 key field personnel, including Field Maintenance Supervisors, Superintendents, Bureau Chiefs and Construction people were present at one or another of these meetings. The gatherings were used as an opportunity to explain the overall purpose of the Maintenance Management System as well as to present specific instructions for correctly collecting data and completing the

newly designed inventory forms. After a brief lecture, a set of completed sample forms was used to explain the required entries. The purpose of each entry was explained and justified. The necessity for accurate collection and reporting of inventory items was made clear. The correct completion of an enlarged inventory form was demonstrated line by line. It was emphasized that for some time construction divisions have used a performance budget base which measures productivity rather than use of resources. This presentation was followed by a question and answer period during which many interesting points were raised and discussed.

A general orientation of the Maintenance Management System will be provided for all Maintenance Division Supervisors early in the conduct of Phase III. The orientation will be scheduled in early February 1982, weather and supervisor time permitting, and will be a one day seminar. A seminar format seems most desirable as it permits a cross-flow of ideas among all Field Divisions and allows key project staff to personnally respond to all questions. This immediate feedback produces the most widespread positive training results.

Training for the data processing section is described in Task 1.11h.

TRAINING PROGRAMS -

One training program will be designed for Field Maintenance Supervisors and Maintenance Superintendents. A second training program will be designed for Field Maintenance Division Chiefs, Field Business Managers, and Maintenance Division and Centralized Services Division staffs. During the first training program the Maintenance Management System and the Supervisor's role in its successful execution will be explained. Advantages of the MMS for these particular classifications of MDOH employees in fulfilling their job responsibilities will be discussed in detail. These points will be stressed during a short lecture followed by a general question and answer period.

An in depth explanation of the use of ADAMs (Activity Description and Accomplishment Method) in planning weekly workloads and in evaluating work efforts will be presented. At this management level, work scheduling for the near future is required. Short lectures, question and answer periods, overhead projections, sample problems, small group discussions, and actual worksheets will be used in order to make the training meaningful. The sample scheduling worksheets will include tasks of increasing complexity as the training session progresses. BTML personnel will be available to work with small groups on a

one to one basis. MDOH employees will be expected to demonstrate familiarity with concepts and ability to correctly complete worksheets. Any problem areas will be used as the basis for further explanations and practice.

Procedures for reporting data into the system will be taught. The need for accurate reporting in order to produce useful management information will be stressed. Overhead projections and actual forms will be used in these demonstrations accompanied by a verbal explanation of the proper procedures and necessity for accuracy. Trainees, working in small groups, will be asked to show evidence of competency by properly completing required forms. Any trouble areas which appear will be the basis for additional instruction.

Supervisors will be provided an opportunity for discussion and sharing of successful practices in completing desired objectives. It will be emphasized that a Maintenance Management System is a way of improving management skills. Through its use, supervisors are able to predict their needs, schedule their work, and measure the performance of those they supervise on an objective basis. The value of the system as it pertains to both individual employees and the MDOH in general will be stressed. Motivation of department personnel to make the necessary changes is as significant as techniques, and this fact will be underscored. The attitude will be encouraged that it is the employees' system and not the consultant's. The continuing operation will be entirely by MDOH personnel for the benefit of MDOH. Attendees will be motivated to detail specific practices where there are differences from the resources or methods outlined in the ADAMs. The groups will be kept to a size in which free interchange of ideas is possible, and leadership and direction for group discussion will be provided.

This training program will be conducted at several locations throughout Montana. Locations will be determined by facilities available and travel times, although it is anticipated that one such training program will be held in each of the 11 divisions. Groups of as many as twenty trainees will attend, although this number can be adjusted as necessary in order to achieve maximum benefits. Each session is expected to be completed in one day, although the length of the session can also be adjusted as necessary.

A "Train-the-Trainer" program will be an extension of the Supervisor's training course for selected individuals in each Field Maintenance Division. Those individuals will be expected to provide indoctrination to new supervisors after the project is completed. Recognizing that training is a con-

tinuous process, training manuals and materials will be developed so that necessary updates can be made with little difficulty. The use of loose leaf binders will facilitate this process as outdated pages can be removed and current pages added with little difficulty.

The second training program will be based on the premise that the higher the management level, the more future planning is required. Field Maintenance Division Chiefs, Field Business Managers, and Maintenance Division and Centralized Services Division Staffs will attend. As the number of employees involved in this training program is fewer than in the first training program, the necessary instruction could be accomplished with one group of approximately 50 persons or two smaller groups. The location will be selected for reasons of efficiency and economy, although broad participation by cutting across organizational lines will be encouraged.

The fact that a Maintenance Management System is a way of improving management skills will be carefully explained and illustrated. The necessity for the full cooperation of MDOH personnel in insuring the success of the system will be emphasized. "The chain only being as strong as its weakest link" philosphy will be stressed. The types of reports available at each organizational level will be presented and discussed. The purpose of each will be examined in detail. Correct completion of report forms will be demonstrated. These objectives will be accomplished by the use of lectures, overhead projections, question and answer periods, sample problems, small group discussions and problem solving activities.

A thorough description of the planning, scheduling and budgeting cycle will be presented. This description will include this process at all management levels from the Field Maintenance Supervisor level to the Maintenance Division Administrator's responsibility. The concepts and operation of the Performance Budget System and its relationship with existing line item accounting and budgeting will be carefully compared. Lectures, question and answer periods, small discussion groups, overhead projections, and sample problems will all be useful tools in accomplishing these objectives. Input reports will also be analyzed and discussed.

Expenditures, work performance, future major rehabilitation needs, and maintenance standards will be examined, analyzed and discussed. This can be accomplished by using actual input reports and past departmental records.

Lectures, overhead projections, small discussion groups, sample problems and problem solving techniques will be employed. As in all training sessions, questions will be encouraged. It is anticipated that trainees will have particular areas of interest which they will wish to explore. These contributions should target topics which need expanding.

Control of work progress and expenditures and the usefulness of input reports in these areas will be explored. The appropriate form and the correct completion of each will be demonstrated. Justification for each required entry on each form will be presented. Once the need for the information is understood, completing the forms becomes less of a task. Following the explanations, sample problems will be completed on an overhead projector. The trainees will be provided an opportunity to complete additional forms as small group projects. Any obvious areas of misunderstanding will be explained in greater detail, and additional practice problems provided. The training pursuant to forms and reports dealing with allocation of funds, manpower, materials and equipment will be presented in a similar fashion.

Once a work plan for the training programs has been approved and the training programs developed, training will start at the MDOH headquarters and at the Field Maintenance Divisions. Initially, training will be provided in a Test Division and for the headquarters staff. It is imperative that the Test Division be selected very carefully as it should be truly representative of the personnel in each division. Training procedures which prove to be successful in the Test Division can then be expected to work equally well in the other divisions.

During the planned training activities in the Test Division, a continuous evaluation of training methods will be conducted. Obvious changes which will make training more meaningful will be introduced immediately. Adjustments in time allowances for various training activities will be made as necessary to insure that the trainees fully understand all phases of the MMS pertinent to their particular job and the participation required from each of them in order to guarantee successful operation of the system.

When training in the Test Division has been accomplished, a careful check of completed forms, computer outputs, and other written data submitted from that division will be carried on. Should particular trouble spots appear in any area, additional training will be provided in order to overcome such difficulties.

Once it has been ascertained that the most efficient and useful training procedures are being used, training will be provided for Supervisors in each of the remaining divisions.

More specific and detailed training, on an individual or small group basis, will be provided to MDOH staff members as needed throughout the system implementation phase of the project. (September 1982 - March 1983)

MR/cp/215C

PLAN

DATA PROCESSING SYSTEM DESIGN

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

PHASE I - SECTION 11

December 1981

PLAN

DATA PROCESSING SYSTEM DESIGN

INTRODUCTION

A Maintenance Management System by its very nature, has many parts as it covers all activities which make up a maintenance program. State highway systems are large and expensive public work facilities and are spread out over large areas. This is particularly true in Montana due the state's size. The only possible way to manage all of the data necessary to control so large a system is through the use of data processing.

A simple determination that the use of computers is appropriate, however, is not a guarantee of desired results. Improper development of computer systems, programs and subsidiary requirements may make the use of computers more harmful than beneficial. This is particularly true in the case of a Maintenance Management System as the total system is large and complex, and many people who may have little or no knowledge of computers are involved. If errors are made during the design stage, it is very difficult to institute corrective changes because maintenance organizations have a great deal of inertia due to their size, diversity and dispersion. For these reasons, data processing systems must be designed very carefully and in an orderly manner. Similarly, it must be presented to the users and be implemented in the same fashion.

While there are many considerations which effect only particular facets of program development, there are two primary concerns which must be considered throughout all aspects of data processing in this project. They are as follows:

1. Ease and accuracy of data collection:

   Those responsible for generating and collecting data are not trained in the use of computers or data processing techniques. If an attempt is made to have overly complex data collection techniques or extraneous information is requested, the opportunity for error greatly increases.

2. Effectiveness of information provided management:

   Management, to be effective, must be provided accurate and timely information in a useful form. It must be appropriate to the management level. If it is not timely, the impact of management decisions is greatly lessened.

GENERAL

For the sake of clarity and ease of following the concepts in the various sub-tasks in the design of the Data Processing System, each one is described from initiation to conclusion in the logical order shown below. Because of time limitations, however, the actual order of work will be modified to begin time critical parts of sub-tasks as soon as possible and to make maximum use of programming capability. The September 1, 1982 check point in the schedule for completion of the budget preparation cannot be allowed to slip. As a result, portions of individual sub-tasks which effect budget preparation will be initiated first and carried through to completion even if the order indicated in the following shows otherwise. Additionally, approval of output and input formats will be requested from the Steering Committee or the Advisory Committee as appropriate on an individual or small group basis to insure that the work flow through Data Processing is as even as possible. It is recognized that a process of this type may cause a slight reduction in overall efficiency and may also produce programs that are somewhat redundant. However, programming refinements can be made in the future and the advantage to be gained in meeting project time restrictions far out weigh those disadvantages.

Internal interdependence between parts of the system and external consideration such as policies, means of measurement, methods of assignment of labor time, and so on will be considered at each step.

The development process will be in the following order:

PAGE	DESCRIPTION
3	Analyze Hardware and Software Requirements (Task 1.11f)
5	Develop System Test Plan (Task 1.11e)
6	Develop Plan for Installation of Automated System (Task 1.11g)
7	Develop User Training Plan - Data Processing (Task 1.11h)
8	Develop Plan for Preparation of Computer User's Manual (Task 1.11d)
10	Define Output Systems (Task 1.11a)
23	Define Field Reporting Forms and Other System Input (Task 1.11b)
25	Develop System Flow Chart (Task 1.11c)

ANALYZE HARDWARE AND SOFTWARE REQUIREMENTS

Within this portion of the system design, several major areas need to be addressed. These areas are existing hardware, data entry, urgency of information and required software policies. The following discuss each of these in more detail.

The first of these, existing hardware, required a review of the equipment available in the central office and each of the field offices as well as any remaining capability for programs and data storage on the field office systems. In general, the central office is tied into the State's Central IBM 3033 system. This is accomplished through terminals and printers located in the Data Processing Bureau's location in the DOH building. They operate under both batch and Remote Job Entry (RJE) systems. They also have available an IBM Series I with three terminals and printer. The Field Bureau's all have IBM Series I with two terminals and one printer. They operate under just the batch system to both the Central 3033's and the Series I located in the Central Office.

The remaining capability of the Series I's in the field offices totals approximately 1.8 megabytes of the total 9.3 megabytes on the systems. The 3033's have no limits as far as the MMS is concerned. Within the tentative layout for data storage for the Montana Management System, the field would be required to maintain only an average of 10,000 characters of information per week with a maximum of approximately 15,000 characters. This is because the system is designed so that all data will be stored centrally. The need for the same information at several levels of management is the main factor behind this type of design. These space requirements fall well within the available hardware and space available in the divisions and centrally at this time.

The next two areas include the data entry needs of the system and the urgency of the information the system is to produce. The two are somewhat dependent on each other in that the urgency of information will dictate the speed in which data must be input, edited and corrected. With an estimated input requirement of 10,000 to 15,000 character input requirement for each division per week, the existing office personnel should be able to handle the added workload without much trouble. Additionally, the work from the Payroll and Equipment should be reduced somewhat so that overall input requirements should increase only slightly, if at all.

The need or urgency of the information with which to manage properly requires that the data be available to produce reports within seven days after the report period is over. This can be accomplished if, at the end of every week, the activity reporting forms are transmitted to the divisions and entered. The editing and correction process can then be performed during the next week so that all data would be available for the reports which would be produced one week after the close of the reporting week.

The last area which needs to be addressed is the type and depth of the specifications for the programs as well as the language in which the programs are to be written. The language to be used in the system will be up to the Department. However, it is recommended that the State follow the standard used in other systems written in the State namely PL/1 due to programmer familiarity and capability with this language. If any of the edit programs are to be performed on the Series I's in the division offices, then the language EDX, already in use on these systems, should be used.

The type and depth of specifications to be used in the program instructions have not been finalized. Discussions with the Data Processing Bureau indicate that the specifications will be of a general nature and will only need to expand on the system flow enough to include the input and the computations necessary for the program to produce its output, be it data files or reports.

DEVELOP SYSTEM TEST PLAN

In order to test the software developed in this system, a test procedure will be designed based on the formulation of a scenario of work performed and projected budget requirements. From this, the calculations within each of the modules will be followed by hand and the output information for reports or files assembled. The same data will then be put into the programs and checked against the manually computed information to insure proper programming. The test information will be followed from one module to another as the need requires. The final testing will be performed when the system is installed in the test division where actual field data can be put into the system with selected data used in duplicate hand computations to compare against program results.

DEVELOP PLAN FOR INSTALLATION OF AUTOMATED SYSTEM

The installation of the Automated portion of the MMS must be in an orderly and easily accomplished manner. The first step will be the construction of the Inventory and Support Files for use in testing of the systems which will be complete in early March.

Next, the final testing of the Management Information Subsystem will take place from early March through the middle of June. This will be followed by the implementation of the MIS in one division to test the system. The testing will last approximately two months. Following this, the MIS will be implemented in the remaining divisions at the rate of approximately two divisions per week starting in the early part of September.

At the same time that the final subsystem debugging is taking place on the MIS, the final testing of PBS will begin. It will continue until approximately the end of July. Following the completion of the testing, the PBS procedures will be implemented with the preparation of a budget ready for submittal to the Director in early September.

Since the MIS reporting will reduce or eliminate some of the information being collected in other systems, care must be taken that during the implementation of MMS needed data is not lost. To make certain of this, the existing systems and MMS will be operated in parallel until the end of the fiscal year, (June 30, 1983). During this time of parallel reporting, checks will be made to insure no information needed will be lost when the revised information to be collected by the other systems is instituted.

DEVELOP USER TRAINING PLAN - DATA PROCESSING

The training for the data processing portion of the MMS will be the same type of training set forth in the non-computer training program. The amount of training needed for the data entry, system users and systems analysts will vary according to the type of contact they have with the MMS.

For the data entry level, the training will be minimal in the field and little to none in the Helena Office. The field's contact with the system is primarily in the entry of the work data so their training will involve mainly the data input needs. The Helena Office will be primarily involved in the input of file update data and original inventory information. The training for these individuals will be of an informal nature on the input requirements.

The system users will be the area in which the greatest amount of training is needed. These users will be the Division Maintenance Bureau Chiefs and the Central Maintenance Office. Within the division, the training will center around field inputs and how to review reports, request additional information and train new field personnel in the reporting of information. The Central Office personnel will have a more informal type of training since they will be more actively involved in the design of the system. The training they will receive will include the reviewing of reports, the requesting of additional information and the producing of the budget information which the system will provide.

The final group of individuals who will require training will be the system analysts. The training will be primarily of the informal type since the design of the systems will be a joint effort between BTML and the State's analysts. Any additional information will be provided in the Computer User's Manual which will assist any future analyst assigned to maintain the system with the information necessary to perform any changes that may occur.

DEVELOP PLAN FOR PREPARATION OF COMPUTER USER'S MANUAL

In addition to the MMS Field Manual being prepared for use by the field and management personnel, a MMS User's Manual will be developed to assist the Data Processing Bureau. Included in the Systems Manual will be program specifications, file format and update procedures.

The development of the User's Manual will be a coordinated effort between the consultant team and the Data Processing Bureau. Discussions will be conducted early in Phase III of the project to assign responsibilities and establish an acceptable program schedule.

The manual will be prepared as the various subtasks are completed, and the final compilation will require a minimum of additional writing. The tentative schedule for completion will be April, 1982, with review of the manual concluded during the early part of May, 1982. Availability of the printed manual will coincide with the test division training scheduled for July, 1982. The Manual will contain the following major sections:

Overview - A description of the three primary subsystems: Performance Budget Subsystem (PBS), Management Information Subsystem (MIS), and Field Management Subsystem (FMS) will be presented outlining program purposes and information.

Program Details - Program details will be developed and documented in the following areas:

Program Input
Program Output
Program Format
Program Functions

File Formats - Field information for both support and internal files will present the following:

Element Descriptions
Element Location
Character Type (alpha, numeric, etc.)
Field Size

Computer Specifications - Detailed computer specifications including a step-by-step procedural outline will be provided to the Data Processing Programmers. Computations necessary for programming completion will also be given.

Update Instructions - Instructions for the initial completion of the input documents and the updating process will be outlined. Edit tables will be included to explain message codes, fatal/non-fatal status and other explanations.

DEFINE OUTPUT SYSTEMS

The first consideration in this part of the computer system design was a review of both the source documents and computer outputs which are currently used by management personnel in the maintenance area. The source documents were used to help determine the effectiveness, quantity and accuracy of the information which is placed into the computers at the present time. The computer outputs were reviewed to ascertain if any use could be made of them in their present format or if adjustment or replacement will be necessary.

Source Documents Currently in Use in the Maintenance Division of MDOH

1. Daily Time Sheet (Form 162)

   The daily time sheet is completed by every field employee in the Maintenance Division of the MDOH. It contains a very brief Description of Work; the Equipment Number which was used in connection with the work; the Class Number to designate the road system such as primary, secondary, and interstate; the Project Number, the first two numbers of which designate the county and the last two numbers of which designate a special cost or study section; the Agreement Number which is a special maintenance or betterment number; a Unit Number which gives the kind of road, whether dirt or gravel, all ramps, two-lane not concrete, and so on; a Work Number; and an Account Number which is 4030 for maintenance. On the remainder of the sheet times and rates are given to establish salary payment.

   The daily time sheet is filled out by each employee each day. It is checked in the Division Office, and the information from it is keypunched. The information is entered into the Division Office Series One Computer on a bi-weekly basis and the information is communicated from that computer by telephone line to the central computer in Helena. The information is processed by Centralized Services for payroll purposes and labor expenses to work numbers are also collected. Equipment numbers are shown on the daily time sheet only for the purpose of justifying employee pay rates as operators of various types of equipment receive pay at different corresponding rates. This daily time sheet also provides a record showing who was operating equipment in case of equipment malfunction caused by abuse or in the event of public complaint.

A daily time sheet will continue to be used after implementation of the MMS to satisfy labor contracts. Its format will be altered, however, with stress on providing payroll information to meet the various requirements of union contracts as regards special and overtime pay. Management information concerning activities and location of work will be collected on new forms to be developed as part of the MMS.

2. Project Estimate (Form 49) and Report of Completion of Special Authorization (Form 158)

These forms, orginating at the section, are used to request approval (Form 49) for general maintenance, special maintenance, betterments, gravel crushing and accounts receivable, and to report (Form 158) the type and location of work accomplished along with the quantity of material handled.

It is anticipated that Form 49 will continue to be used for betterment work. For work which is considered to be routine maintenance, the MMS scheduling document will be used as a replacement.

Form 158 will be replaced by the MMS work input form.

3. Monthly Equipment Rental Record (Form 905)

This form shows the hours that each piece of equipment is assigned to various work numbers on a day by day basis. A charge is then made for the "assigned portion" of the rental rate. It also shows total miles that each piece of equipment is used for the month. The "mileage portion" of the rental charge is then made to various work numbers based on a proportion of assigned hours for each activity to total assigned hours. This document is the only basis for making equipment charges to various work numbers. The month used on this report is a fiscal month based on requirments of the controller to have all costs in and checked by the end of the actual month. As a result, the usual end of the month for purposes of equipment reporting generally occurs no later than the end of the third week and in many cases at the end of the second full week. The form must be submitted to the Division Office by the 20th of each month. No correlation is made between labor hours and equipment hours since labor hours are on a bi-weekly schedule and equipment is on a monthly schedule.

The equipment rental record is prepared in the divisions and mailed to Helena for keypunching. Reportedly, it is quite common to submit this

form every two or three months rather than monthly when there is sufficient room on the form for entries during the extended period.

It is anticipated that a substantial change will have to occur in this form as a result of the development of the MMS. The reporting periods will also have to correspond to the MMS and payroll bi-weekly periods. In all probability, weekly periods will be the period selected for most compatability between monthly or bi-weekly reporting systems in use in State Government. The equipment management system is presently under development and arrangements will be made to insure compatability.

4. Vehicle Operators Daily Report (Form MT 901A)

This form is for motor pool vehicles only and is seldom used in connection with those activities which will be considered in the Maintenance Management System. It contains operator codes, and as is the case for the monthly equipment rental record, it is also keypunched in Helena.

5. Transfer - Warrant Claim (Form 231-Hwy)

All materials and supplies used in the Highway Department are coded on this form. The coding is similar to that found on the daily time sheet in that it contains Class, Project, Agreement, Unit, Work Number and Account Number. The equipment number is not shown. Quantity and unit measures are included together with some accounting data. It is filled out for every transaction and authorizes payment from the appropriations or funds shown. The information is keypunched in Helena and costs collected for monthly and yearly reports.

It is not visualized that any alteration of this form will be required due to MMS, although some of the data from it will have to be used in conjunction with MMS for material costs. It will also be necessary to issue special instructions for completing the form in some instances involving material to be used in connection with maintenance activities.

6. Inventory Code and Summary Sheets (Form 79C & Form 79A)

These forms are completed in the field divisions and the coding is about the same as for the daily time sheet. The primary purpose as far as the Maintenance Management System is concerned, is that it would supply a record of:

- road oil;
- aggregate;
- premixed bituminous material.

The primary coding form is 79C and form 79A is used for journal corrections. They are used to update quantities and costs and are sent to Helena for review and keypunching. The information from this form is used to establish the cost of the work numbers that would involve the above material.

Consideration will be given to recommending changes in this form to account for the new maintenance activity numbers. In any event, some special instructions will have to be issued for using the form in connection with maintenance activities.

7. Budget Requests

The budget requests are standard and typical of those found in similar organizations to the MDOH. They are developed in the Field Maintenance Bureau at the request of the Maintenance Division. They are in line format by object code such as kinds of salary payments, expenses, material costs, and so on. They are based on historical records and anticipated cost increases. Back up and justification data is included as appropriate. Special maintenance and betterment projects are also included. The information is collated in the Maintenance Division and incorporated into the total Departmental budget where it is modified and adjusted as required. It is part of the legislative and executive process of budgeting.

Computer Produced Reports Currently in Use for Management Information

1. Budget as approved by Legislature - State Budget Office.

These are budget documents produced by a computer which merely show the approved budget by line item and are prepared by the State Budget Office.

2. SBAS Report (SBAS Form 662)

These reports are issued both monthly and as a yearly summary. They are financial in nature; and expenditures are given by object code which, for example, include personnel services. This object code can be further broken down into salary, regular salary, overtime, holiday, and so on.

This report shows budgeted funds, current month expenditures, current year expenditures, prior year expenditures, encumbered funds, balance, and percentage of budget expenditure. There is no indication of quantity or measurement of any kind, except dollars.

3. 4030 Report

This report is issued monthly and with a yearly summary. It shows expenses charged to work numbers by division, with the information ordered by: Division, Class, Project, Agreement, and Unit but not by Work Number.

As a result, to find the cost of a kind of work in a division requires a substantial amount of manual effort. A quantity of product used or measurement of work is not shown, but only financial expenditures.

Proposed Budget and Work Program Subsystem Computer Reports

The information contained in this section should be used in conjunction with the document entitled "Plan, Budget and Work Program Subsystem Development" (PBS).

Phases I through IV shown in parenthesis, which are included in the following descriptions, refer to that plan.

1. Pre-Budget Report (Phase I):

This report will contain an inventory update of physical, traffic and environmental characteristics. It will also include a unit cost update with both current and projected costs. It will review cost trends from previous years as a means of projecting future costs. There will also be an updated listing of activities.

2. Total Work Needs Statewide (Phase II)

This is a preliminary performance budget report that will give the total work needs and estimated costs by activity. It will include the previous needs which were not satisfied, work scheduled but not performed, and work not budgeted from previous years which could be carried over. Constraints based on available resources, including financial, will not be taken into account for this report.

Maintenance Division Managers will be provided information to:

- assist in understanding maintenance needs on the Highway system
- review and modify maintenance policies, if necessary
- establish maintenance program goals
- establish priorities among activities

3. Summary of Work Budgeted - Statewide (Phase II)

This is a preliminary performance budget report that will supply information on work units budgeted for both state and contractual services

and costs for performing the work by activity. The Administrator of the Maintenance Division will be furnished information on labor, equipment, and material resource costs and contractual service costs in order to implement the maintenance program. Adjustments can be made by adjusting service levels, consequential work loads, and total work needs based on information from the previous report. Program may be re-run until resource and dollar limitations are satisfied.

4. Labor Requirements By District & Summary Statewide (Phase II & Phase IV)

   During Phase II this report will be used by the Administrator of the Maintenance Division and during Phase IV, it will be used to develop a working budget by the Field Maintenance Bureau Chiefs.

   This report will provide information on personnel requirments, manpower needs and hours. It will be used during development of the requested budget and also for modification of the approved budget. It will be used to assist in adjusting division workloads to meet resource and dollar limitations. It may also be used to justify additional personnel and work budgeted or to adjust manpower authorization.

5. Equipment Requirements By Category By Division (Phase II & Phase IV)

   This report will supply information on equipment requirements by category for activity assignment. Space will be allocated for assignable hours which it is expected will be an output of the Equipment Management System currently under development. It will be used to assist in adjusting equipment resources by the Administrator of the Maintenance Division during the preliminary stage and by Field Maintenance Supervisors during preparation of the final budget.

6. Material Requirements By Category By Division (Phase II & Phase IV)

   This report will supply information on material requirements by category including costs and the maintenance activity requiring the material. It will assist in determining material resources to meet work budgeted by the Administrator of the Maintenance Division during pre-budget preparation and by Field Maintenance Bureau Chiefs during final budget preparation.

7. Performance Budget To Line Item Budget (Phase III)

   This report will provide information on the direct correlation between the activities of the performance budget and the line item budget codes applicable to maintenance appropriations in a matrix format. Broad

groups of line items will be shown in the matrix. It will be produced for each fiscal year of the budget period and for quarters of each fiscal year as well. It will be used as one of the base documents of the budget submittal. After final approval, the information will be transferred to the Management Information Subsystem in order that expenditures may be checked against budgeted amounts.

8. Detailed Line Item Budget (Phase III)

This report will provide detailed budget in line format in conformance with the requirements of the SBAS. It will be produced for each fiscal year of the budget period and for quarterly periods as well. It will be used as one of the base documents for budget submittal. After final approval, the information will be transferred to the Management Information Subsystem to check expenditures against budgeted amounts.

9. Total Work Needs - Work Budgeted And Not Budgeted (Phase IV)

This report will provide information on total work needs, work budgeted, and will include budgeted information by quarter for the final budget report. It will also show contract work budgeted and non-budgeted. The report will allow for an analysis of the work requirement by quarter for the fiscal years that are budgeted. This analysis will be based on policies or projected needs. It will show that portion which can be accomplished based on constraints imposed through resource limitations. After final approval, the information will be transferred to the Management Information Subsystem to check expenditures against budgeted amounts.

10. Manpower Requirements Based On Maintenance Needs (Phase IV)

This report will show a listing of manpower requirements by division based on work needs.

11. Scheduled Work Planned By Major Activity (Phase IV)

This report will show scheduled work planned by division by four week period and quarter as appropriate. It will show estimated work load, special equipment, and those activities requiring multiple crews. It will establish the basis for Field Maintenance Bureau Chiefs, Superintendents, and Supervisors to schedule the remaining activities which must be scheduled around major ones.

TABLE 1

PROPOSED PBS REPORTS AND DISTRIBUTION

	PBS PROPOSED REPORTS	MAINTENANCE SUPERVISOR	MAINTENANCE SUPERINTENDENT	DIVISION FIELD BUREAU CHIEF	MMS COORDINATOR	STATE ADMIN. MAINT. DIV.
1.	Pre-Budget Report				●	
2.	Total Work Needs - Statewide			●	●	
3.	Summary of Work Budgeted - Statewide				●	●
4.	Labor Requirements By District & Summary-Statewide			●	●	●
5.	Equipment Requirements By Category By Division	●			●	●
6.	Material Requirements By Category By Division			●	●	●
7.	Performance Budget To Line Item Budget				●	
8.	Detailed Line Item Budget				●	
9.	Total Work Needs-Work Budgeted and Not Budgeted				●	
10.	Manpower Requirements Based On Maintenance Needs			●	●	
11.	Scheduled Work Planned By Major Activity	●	●	●	●	

DH/dk/202K

Proposed Management Information Subsystem Computer Reports

The Maintenance Management Information Subsystem will provide three basic types of management information for Central Administration as well as field personnel.

This information is grouped as follows:

1. Control of Maintenance Work and Cost
2. Evaluation of the Effectiveness of Maintenance Work
3. Comparison of the Budget and Schedule to the Actual Accomplishment and Costs.

The following information describing output information should be used in conjunction with the document entitled "Plan-Management Information Subsystem Development."

1. Section Accomplishment and Unit Cost Report

   This report is designed for use by the Maintenance Field Supervisor. It shows man-hours expended by secton and division for the month and year-to-date. Accomplishments per man-hour and unit costs for the section and the division will also be shown for the month and year-to-date, along with a percentage comparison. A travel distance by section and division will be shown to assist in the analysis of the accomplishment per man-hours.

2. Work Accomplishment Report

   This report will be prepared at both the section and state level. Units of work scheduled and completed for the month and year-to-date will be indicated as will dollars budgeted and expended. Maintenance Superintendents and the Administrator of the Maintenance Division will have current status reports on the work accomplished in their jurisdictions and a check on progress towards implementation of the annual Maintenance Work Program.

3. Accomplishment/Unit Cost Exception Report

   This report will be prepared for the Division Field Bureau Chief and the Maintenance Superintendent. Information concerning activities where accomplishments per man-hour or costs exceed an established limit will be presented. The limit will be based on the mean division accomplishment rate and cost.

4. Labor Hour Verification Report

This report will provide a comparison between labor hours recorded against the Maintenance Management System and the payroll system. This check on the accuracy of the field reporting will provide important information concerning the consistency of MMS and the development of labor costs.

5. Equipment Utilization Verification Report

This report will provide interface information obtained from MMS and EMS. A comparison of equipment utilization as reported by MMS and EMS will insure that complete reporting is being accomplished and that realistic costs are being generated.

6. Stockpile Analysis Report

This report designed for use at the division level will present information obtained from the three stockpile activities. Quantities and values of the division stockpiles will be shown. Additions to the quantity of material and value after monthly production will be indicated. Any reductions occurring as a result of monthly utilization will also be shown. An end of the month quantity and value will then be assigned.

7. State Accomplishment Report

This report contrasts and compares standard accomplishment rates with the average statewide rate and the rate reported by each of the maintenance divisions. The information presented on this report provides valuable input into the planning/updating process for an evaluation of the Activity Description and Accomplishment Method.

8. State Unit Cost Report

This report provides information for comparisons to be made between various work methods. The accomplishment rate can be analyzed to evaluate the effectiveness of the operation and assist in the optimum labor/equipment/material configuration reguided for each of the Activity Description and Accomplishment Methods.

9. Division Man-Day Utilization Report

This report provides the Division Field Bureau Chief with information to assist with the scheduling of the annual Maintenance Work Program. Man-days reported to a specific maintenance activity for the division will be listed on a monthly basis.

10. Statewide Man-Day Utilization Report

This report provides a check on the statewide scheduling of the annual Maintenance Work Program. Man-days reported to each of the specific maintenance activities, statewide, will be displayed.

11. Location Analysis Report

This report, prepared on request, provides detailed information on a specific route between defined beginning and ending mileposts. Accomplishments, resource costs and total costs will be displayed against a specific maintenance activity.

12. Activity Analysis Report

This request report provides specific information on a particular route or portion of a route as performed in a particular maintenance section. Work accomplishment, resource costs, travel distance and unit costs will be shown.

13. Summary of Equipment Hours - Division

This report will show division equipment utilization on an hourly or mileage basis. An analysis of the division equipment requirements for the year can then be completed.

14. Summary of Equipment Hours - Statewide

This report will provide division equipment utilization on an hourly or mileage basis. An analysis of the statewide equipment requirements for the year can then be completed.

15. Summary of Material Usage - Division

This report will display the division material usage on a monthly basis. The report will then be used to assist the Maintenance Division with planning for material purchases.

16. Summary of Material Usage - Statewide

This report will display the statewide material usage on a monthly basis. The report will then be used to assist the Maintenance Department with planning for material purchases.

17. Budget vs. Expenditure

This report provides an overall reconciliation of the performance and line items budgets with actual expenditures. Costs utilized in the budgeting process and the actual expenditure associated with the scheduled work will be displayed on this report.

18. Cost of Work Scheduled and Completed

This report provides information on the costs of scheduled and actual accomplishments by maintenance and contractual forces. The report will assist in monitoring actual costs against scheduled cost, determining activities which show a variance from the budget and the extent of variance between resources used and resources budgeted.

TABLE 2

PROPOSED MIS REPORTS AND DISTRIBUTION

MIS PROPOSED REPORTS	MAINTENANCE SUPERVISOR	MAINTENANCE SUPERINTENDENT	DIVISION FIELD BUREAU CHIEF	MMS COORDINATOR	STATE ADMIN. MAINT. DIV.
1. Section Accomplishments and Unit Cost Report	●			●	
2. Work Accomplishment Report - Section		●	●	●	
Statewide				●	●
3. Accomplishment/Unit Cost Exception		●	●	●	
4. Labor Hour Verification Report			●	●	●
5. Equipment Utilization Verification Report				●	●
6. Stockpile Analysis Report			●	●	●
7. State Accomplishment Report				●	●
8. State Unit Cost Report				●	●
9. Division Man-Day Utilization			●	●	
10. Statewide Man-Day Utilization Report				●	●
11. Location Analysis Report (Request)	●	●	●	●	●
12. Activity Analysis Report (Request)	●	●	●	●	●
13. Summary of Equipment Hours - Division			●	●	
14. Summary of Equipment Hours - Statewide				●	●
15. Summary of Material Usage - Division			●	●	
16. Summary of Material Usage - Statewide				●	●
17. Budget vs Expenditure				●	●
18. Cost of Work Scheduled and Completed		●	●	●	

DH/dk/202K

DEFINE FIELD REPORTING FORMS AND OTHER SYSTEM INPUT

The coordination of numerous input documents will be necessary to fulfill the requirements of the Performance Budget Subsystem (PBS), Management Information Subsystem (MIS) and the File Management Subsystem (FMS). A listing of the required documents has been compiled and can be found on Table 3.

Each of the 21 input documents have been reviewed and coded with the following information;

CONTENT - A brief description of the items included on the document or file.

ORIGIN - The individual or bureau within the Highway Department responsible for the availability of the document.

UPDATED/REVIEWED - The time frame during which input documents should be reviewed for accuracy and updated as required.

STATUS - Each input document has been given one of the following status designations:

Existing - The document currently exists and may or may not require modification due to MMS.

To Be Developed - The document will be developed in conjunction with the MMS.

Proposed - The document will need to be developed, but design is not considered part of MMS.

To obtain information on the input document process this discussion should be used in conjunction with the Develop System Flow Chart Section in this report.

TABLE 3

MMS SYSTEM DOCUMENTS

DOCUMENT OR FILE	CONTENT	ORIGIN	UPDATED/REVIEWED	STATUS
Physical Inventory-Count	Location and count of maintainable features on the system.	Maintenance Section	-	Existing
Physical Inventory-Length	Location and length of maintainable features on the system.	Maintenance Section	-	Existing
State Highway Computer Inv.	Location of maintainable features on the system.	Data Processing	-	Existing
Physical Inventory Update	Location of maintainable features removed or constructed.	Bureau of Construction Maintenance	Prior to final payment	Proposed
Activity Description and Accomplishment Method	Resources required to perform a unit of work on an activity.	Steering Committee	Annually	To Be Developed (MMS)
Resource Cost	Costs for a unit of each resource for an activity.	MMS Coordinator	Annually	To be Developed (MMS)
Supervisor Name File	Name identifying Section Supervisor	MMS Coordinator	Following Organization Changes	To be Developed (MMS)
Supervisors File Area	Routes and locations identifying sections.	MMS Coordinator	Following Organization Changes	To be Developed (MMS)
Maintenance Work Input Form	Location activity date, amount, resources used on maintenance work.	Maintenance Section	Annually	To be Developed (MMS)
Contractural Maintenance Work	Cost and accomplishment of maintenance done by contract.	Central Admin. - Maintenance	Prior to final payment	To be Developed (MMS)
Manually Scheduled Work	Weekly work schedule for the section.	Maintenance Section	Annually	To be Developed (MMS)
Manually Planned Work	Monthly plan for the Division.	Maintenance Division	Annually	To be Developed (MMS)
Equipment Utilization	Equipment utilization as reported by the EMS.	Equipment Management System	Annually	Proposed
Needs Survey	Maintenance requirements by location, amounts and estimated cost.	Maintenance Sections	Annually	To be Developed (MMS)
Labor Hours and Costs	Total amount of payroll hours and rate.	Payroll System	Annually	Existing To Be Revised (MMS)
Service Level Adjustment	Reduction or increase in workload based on policy of service level.	Director of Highways	Annually	To be Developed (MMS)
Workload Model	Activity accomplishment units per maintainable feature.	MMS Coordinator	Annually	To be Developed (MMS)
Maintenance Budget Guidelines	Specifies maintenance budget limitations.	Director of Highways	Annually	Existing
Budgeted Betterment Work	Accomplishment Units and Costs Budgeted For Betterment By Maintenance Forces	Central Admin. Maintenance	Annually	To Be Developed (MMS)
Contractual Maintenance Budget	Work units and cost of budgeted contractual maintenance.	Central Admin. Maintenance	Annually	Existing

Rev'd 1/8/82

DEVELOP SYSTEM FLOW CHART

The final step in the system general design is to define the processes which take place in order to convert the system input into the reports necessary for the managing of maintenance work. In order to accomplish all of the management tasks, the MMS has been divided into three subsystems: Management Information Subsystem, Performance Budgeting Subsystem and File Management Subsystem. The functions of the first two have been described elsewhere. The last, File Management, is used as a subsystem where files necessary to both of the other primary subsystems are maintained. They include such files as the Inventory File, Supervisor's Area File, Supervisor's Name File, etc. The relationship of each of the three subsystems is shown on Figure 1. The figure indicates the type of information that is passed between the subsystems.

The first subsystem (MIS) passes the information on maintenance work performed through a series of programs to produce the information necessary for management to perform its assigned tasks. In order for the subsystem to function, it must obtain information from the other two subsystems as well as information from other DOH Systems (Payroll and Equipment Management). Figure 2 shows the information flow along with brief descriptions of the functions of each of the programs in modules within the subsystem.

The next subsystem (PBS) is used to generate a budget for maintenance through the use of mathematical models, inventory, variable service levels and other necessary data. The PBS uses primarily the FMS for source data although the MIS is used in informal reviews. The Payroll and Equipment Management Systems are also used to develop anticipated unit costs for labor and equipment. Figure 3 shows the general flow from the beginning of the budgeting computer process through to the final products. It should be noted that the Preliminary, Modified and Final Budget Programs can be run a number of times in order to produce a multiple of trial runs from which to choose. In addition, only a select core of reports are produced automatically by the system with the remainder being requested by the user.

The last subsystem (FMS) is for the updating of the support files; ADAMs, Supervisor's Area, Supervisor's Name, Unit Cost and Inventory. The information

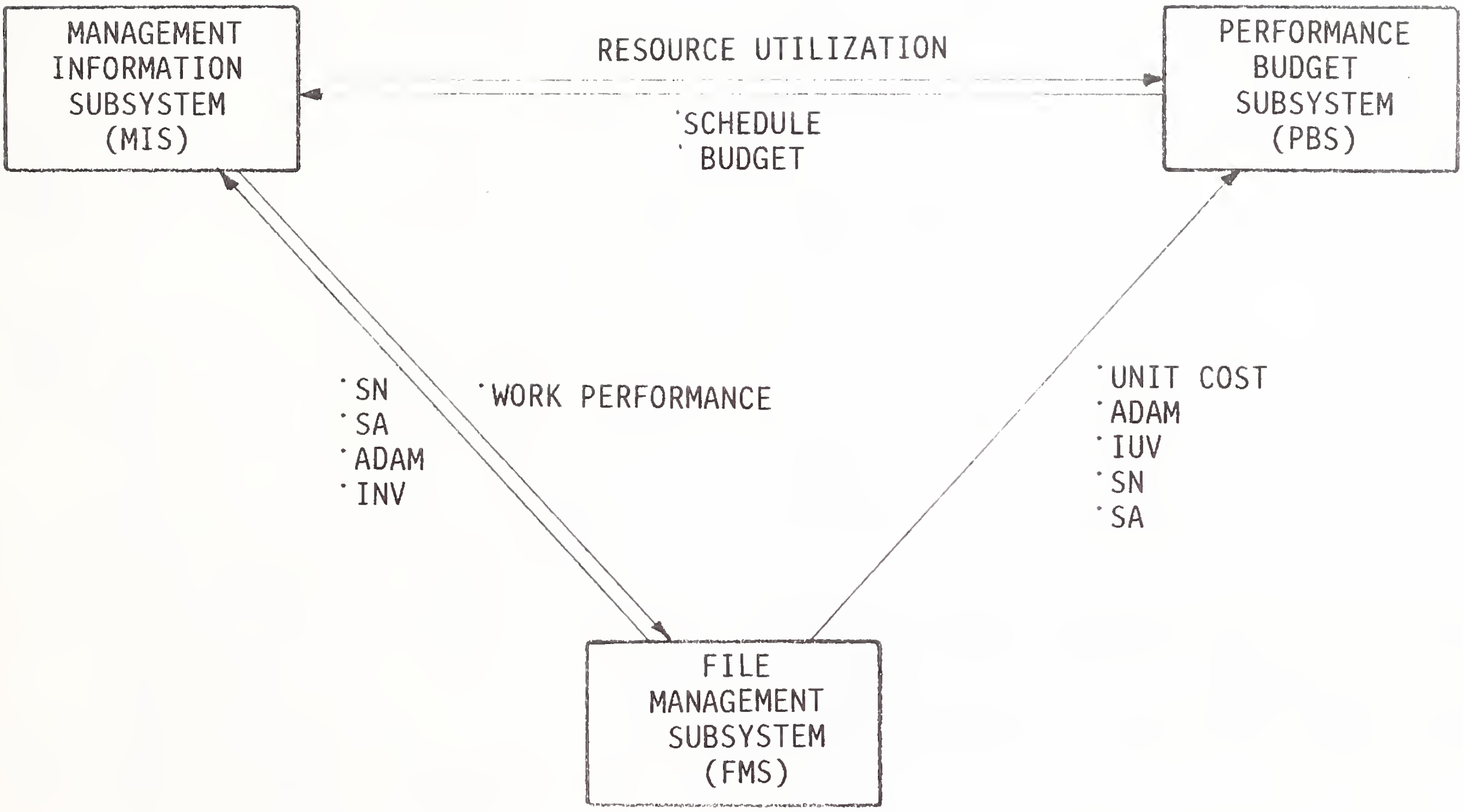
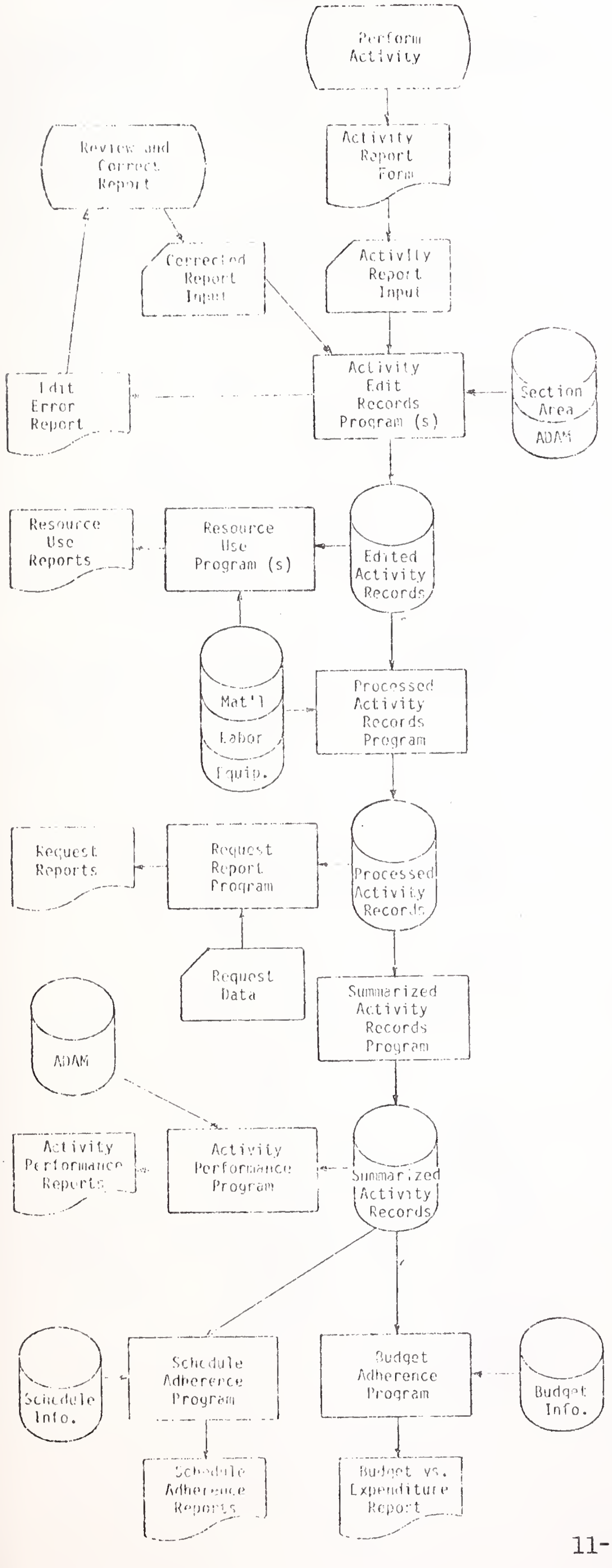

MANAGEMENT INFORMATION SUBSYSTEM (MIS)
RESOURCE UTILIZATION
PERFORMANCE BUDGET SUBSYSTEM (PBS)
·SCHEDULE
· BUDGET
·SN
·SA
·ADAM
·INV
·WORK PERFORMANCE
·UNIT COST
·ADAM
·IUV
·SN
·SA
FILE MANAGEMENT SUBSYSTEM (FMS)

FIGURE 1 RELATIONSHIP OF SUBSYSTEMS WITHIN THE MAINTENANCE MANAGEMENT SYSTEM

FIGURE 2 - MANAGEMENT INFORMATION SUBSYSTEM

WORKFLOW


Perform Activity
Activity Report Form
Review and Correct Report
Corrected Report Input
Activity Report Input
Edit Error Report
Activity Edit Records Program (s)
Section Area ADAM
Resource Use Reports
Resource Use Program (s)
Edited Activity Records
Mat'l
Labor
Equip.
Processed Activity Records Program
Request Reports
Request Report Program
Processed Activity Records
Request Data
Summarized Activity Records Program
ADAM
Activity Performance Reports
Activity Performance Program
Summarized Activity Records
Schedule Info.
Schedule Adherence Program
Budget Adherence Program
Budget Info.
Schedule Adherence Reports
Budget vs. Expenditure Report

PROGRAM FUNCTIONS

Activity Edit Record Program (AER) - This program performs edit checks on the Management Information as it comes from the field. Edits would include both fatal and nonfatal checks.

Processed Activity Record Program (PAR) - This program would apply costs to the resources used and sum those costs to get labor, equipment, material and total costs. Activities reported on multiple lines would be combined so that activity information would be placed on a single record.

Summarized Activity Records Program (SAR) - This program summarizes the information for each of the individual activities for both the section and division for each period.

Resource Use Program (RUP) - This program will be used to produce the resource use reports. They will combine the resources used from the Activity Edited Records File for all activities into resources used by area.

Request Report Program (RRP) - This program produces the reports for specific information requested. The program matches the Processed Activity Records File against the requested information to produce the report desired.

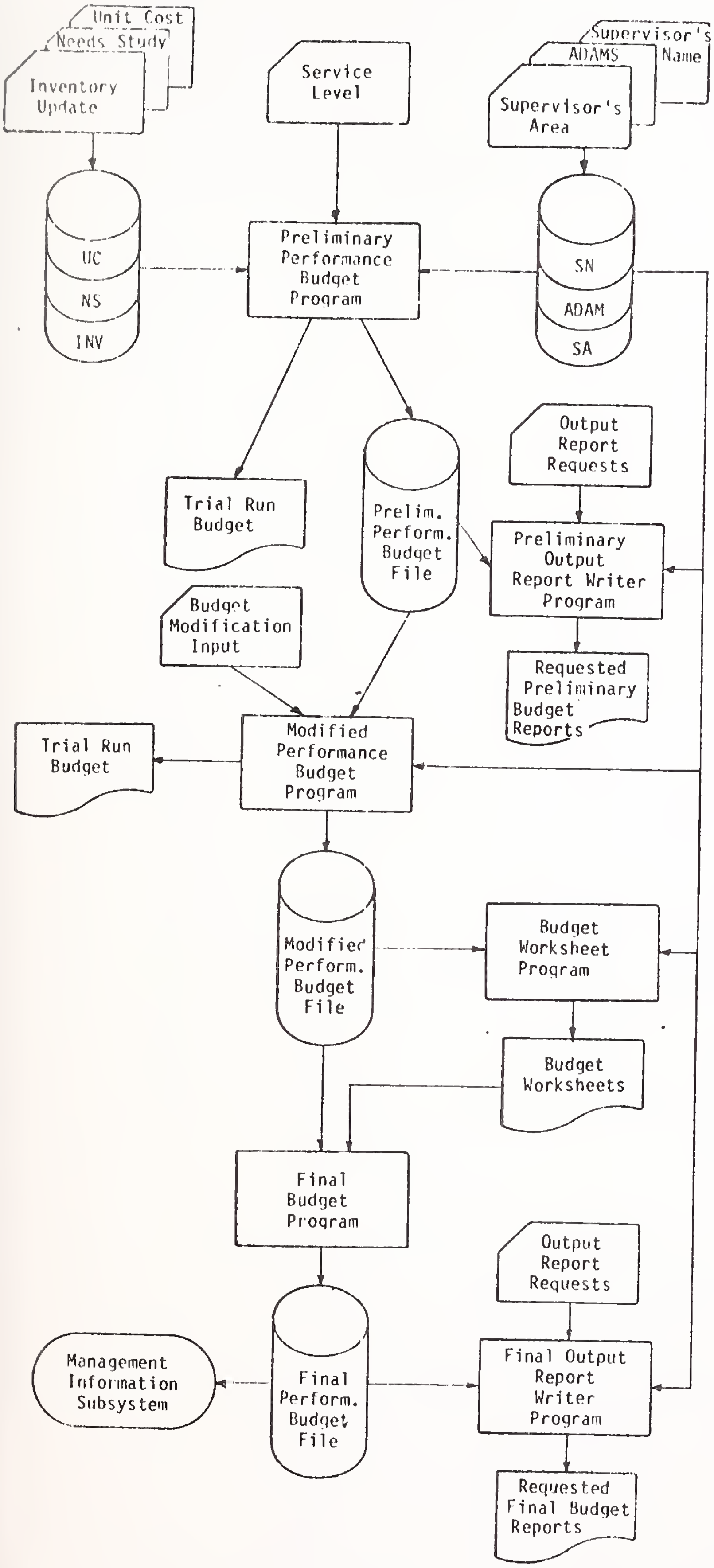
Activity Performance Program (APP) - The program produces the reports providing information of the performance of the maintenance activities. The program will summarize the work performed for the period and compare against standard productivity and unit costs to produce exceptions to the standards.

Schedule Adherence Program (SAP) - This program compares the work performed for the period against the work scheduled for the same time. The information will be shown both in total and by exception.

Budget Adherence Program (BAP) - This program will be used to produce reports that show the dollars budgeted for a period and compare it to the dollars expended for the same period.

FIGURE 3 - Performance Budgeting Subsystem

WORKFLOW


Unit Cost
Needs Study
Inventory Update
UC
NS
INV
Service Level
Supervisor's Name
ADAMS
Supervisor's Area
SN
ADAM
SA
Preliminary Performance Budget Program
Trial Run Budget
Prelim. Perform. Budget File
Output Report Requests
Preliminary Output Report Writer Program
Requested Preliminary Budget Reports
Budget Modification Input
Trial Run Budget
Modified Performance Budget Program
Modified Perform. Budget File
Budget Worksheet Program
Budget Worksheets
Final Budget Program
Output Report Requests
Management Information Subsystem
Final Perform. Budget File
Final Output Report Writer Program
Requested Final Budget Reports

PROGRAM FUNCTIONS

Preliminary Performance Budget Program (PPB)- This program generates the Preliminary Performance Budget through computation of work needs, resource requirements, and costs. This program produces a trial and budget displaying this information as well as storing the information on file. Multiple runs can be made and stored for determining the best budget for the fiscal year.

Preliminary Output Report Writer Programs (POR) - The program reads the Preliminary Performance Budget File and generates reports that are requested.

Modified Performance Budget Program (MPB) - This program modifies the Preliminary Budget through similar procedures followed in the PPB Program. The products of this include trial budget report and the Modified Performance Budget File similar to the products of the PPB Program.

Budgeted Worksheet Programs (BWS) - This program produces the budget worksheet for use in distributing the Modified Performance Budget work over the fiscal year calendar.

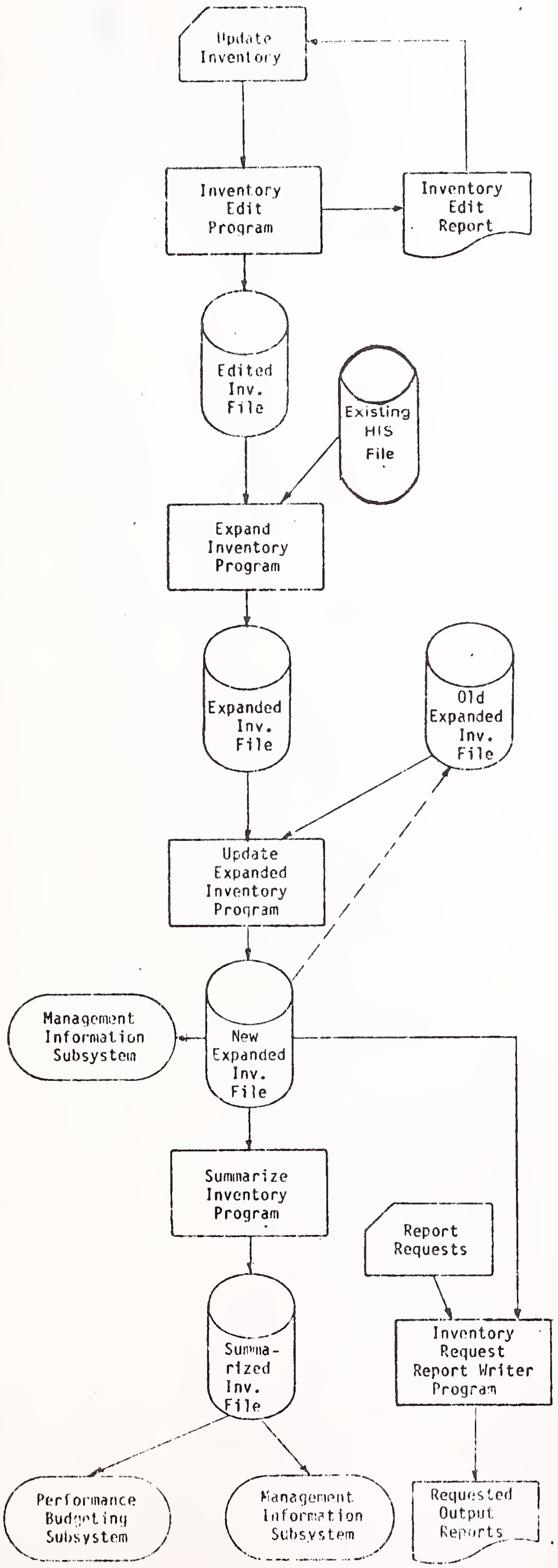
Final Budget Program (FBP) - The program uses the Modified Performance Budget File and budget worksheets to produce the Final Performance Budget File. The file is used in the Management Information Subsystem.

Final Output Report Writer Program (FOR) - This program uses the Final Performance Budget File and output report requests to produce the requested final budget reports.

used within this subsystem is primarily internal in nature with only some information on work performance being supplied by the MIS. In addition, information on the unit costs of the resources will come from the appropriate divisions or bureaus in the DOH. Figures 4 and 5 show the update procedures for inventory (Figure 4) and the other files (Figure 5).

FIGURE 4 - File Management Subsystem

WORKFLOW



PROGRAM FUNCTIONS

Inventory Edit Program (IEP) - This program does an edit on the incoming inventory data and produces the Edited Inventory File. Also produced is a report on all records not passing the edits.

Expand Inventory Program (EIP) - The program takes the different sources of data and puts it onto a single record for each mile.

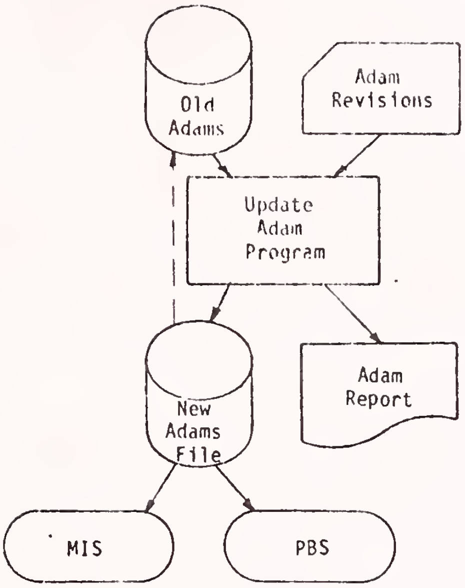
Update Expanded Inventory Program (UIP) - This program updates the existing Expanded Inventory File with the new information to produce the new Expanded Inventory File.

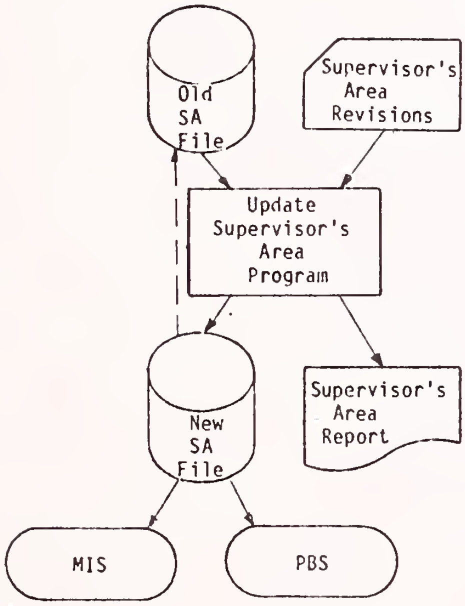
Summarized Inventory Program (SIP) - The program combines the inventory records on the Expanded Inventory File to give total information by section by route system.

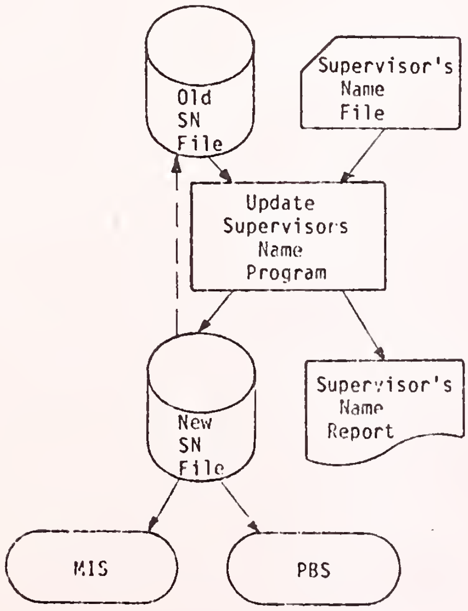
Inventory Request Report Writer Program (IRW) - This program produces reports that are requested using Expanded Inventory File and/or Summarized Inventory File.

FIGURE 5 - File Management Subsystem

WORKFLOW



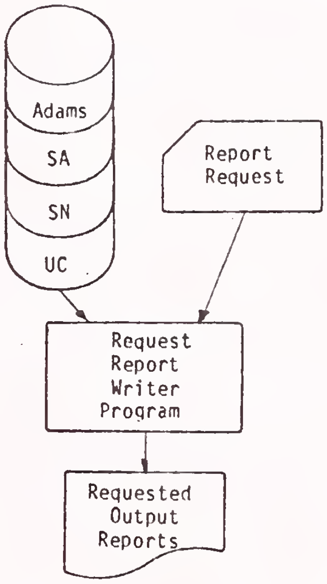


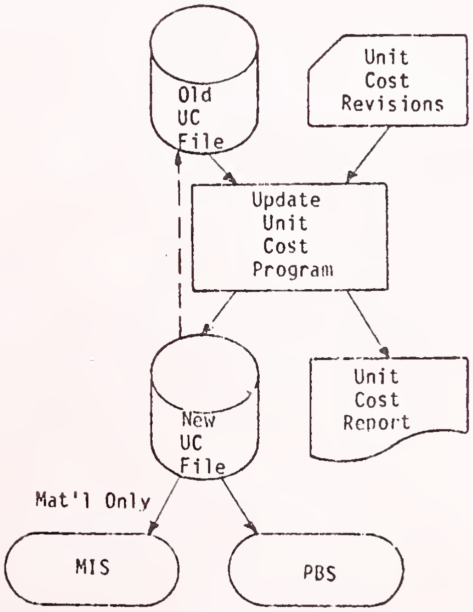


PROGRAM FUNCTIONS

Update Programs (UAP, USA, USN, UCP) - These programs will be used to update the various files through combining the existing files with revision data to produce the new file and information report.

Request Report Writer Program (RWP) - This report would read the existing files and produce the reports based on the requests supplied.





APPENDIX

CORRESPONDENCE REGARDING: PHASE I APPROVAL

MAINTENANCE MANAGEMENT SYSTEM

MONTANA DEPARTMENT OF HIGHWAYS

JANUARY 1982

DEPARTMENT OF HIGHWAYS

TED SCHWINDEN, GOVERNOR
2701 PROSPECT
STATE OF MONTANA
HELENA, MONTANA 59620

January 6, 1982

Martin C. Rissel
Project Director
Byrd, Tallamy, MacDonald, & Lewis
Consulting Engineers
Helena, MT 59620

Dear Mr. Rissel:

A review of your External Design for the Montana MMS has been conducted by the Advisory Committee.

In general, the committee is pleased with the External Design and compliments you on your efforts to date. There are, however, several items needing further clarification before complete approval can be given for Phase I. They are:

1. Costs of maintenance and activities do not appear to include fringe benefits. The design must include a method of adding, fringe benefit add-ons as a cost of performing each work activity.

2. Costs, other than direct maintenance costs, such as utilities, maintenance contracts, etc., which relate to maintenance but are separate from work activity costs, must be captured by the system design.

3. The system must include a method of identifying account receivable activities, both collectable and uncollectable.

4. Reporting of activity 7202 must include a breakdown of quantities used of sand; sand/salt mixture; chemicals, etc.

5. On page 11-24 of External Design in Table 3, the Needs study status is indicated as "Proposed". The status should be changed to "To Be Developed" in conjunction with the MMS. We find this item to be an essential part of the system.

6. MMS expenditures must balance with State SBAS expenditures, therefore, the system must capture all maintenance costs associated with each activity including direct, indirect, and material costs. Section 3.10 on page 5-23 of your proposal

AN EQUAL OPPORTUNITY EMPLOYER

states the system will be designed to do that. The External design does not clearly indicate a plan on how it will be accomplished.

7. On page 1-4 of the External design, the word "expected" will be removed from the expected low, and expected high in the Adam.

8. In the RFQ, Pg. 8 - Item 9, it requires the consultant to develop a plan for improving shop scheduling and reporting procedures to provide decision making information.

   Section 9 of the External design describes B.T.M.L. findings as a result of a field trip and we concur in your findings. Now we want the external design to describe the plan which will be used to develop improved shop scheduling and reporting procedures as planned under tasks 3.7, 3.8 and 3.9.

The Advisory Committee requests B.T.M.L. to respond to the above matters of concern. A supplemental report to be attached to the External design will be acceptable. If you also desire an audience with the Advisory Committee to verbally explain these items, we are ready at any time to meet with you.

Sincerely,

L S Harris

L. S. Harris, Coordinator
Management Systems

LSH:mb:7H

cc: B.T.M.L.
Mr. Lloyd Byrd
2921 Telestar Court
Merrifield P.O. Box 504
Fairfax County, VA 22116
Gary Wicks
Advisory Committee (6)
George Swartz

LLOYD G. BYRD
ROLAND H. BERGER

WILLIAM R. MASLIN
DOUGLAS H. BEESON
RAYMOND A. KOENIG

BYRD, TALLAMY, MACDONALD AND LEWIS
CONSULTING ENGINEERS
2921 TELESTAR COURT
MERRIFIELD P. O. BOX 504
FAIRFAX COUNTY, VIRGINIA 22116
TELEPHONE (703) 698-9780

BERTRAM D. TALLAMY
Founder, Retired

January 13, 1982

L.S. Harris, Coordinator
Management Information Systems
Montana Department of Highways
2701 Prospect Avenue
Helena, MT 59620

Dear Mr. Harris:

This is in reply to your letter of January 6, 1982 in which you delineated items of concern to the Advisory Committee in its review of the Phase I External Design Report of the Montana Maintenance Management System. The report had been sent to you under a letter of transmittal dated December 23, 1981.

Each of the items was reviewed in detail to insure that all of the concerns of the Committee would be completely satisfied. For the most part, the response is in the form of proposed changes or additions to pages of the report, and draft copies of these pages are attached. If you consider that they, combined with the information provided below, satisfactorily answer the concerns of the Advisory Committee, please so advise me. Additional copies will then be made and forwarded to all holders of the report so the pages may be replaced. As an alternative we will, of course, replace the pages if the reports are returned to us. In the event you wish additional modifications to our proposed revisions we will naturally consider them as well.

For the sake of clarity, each of the concerns in your letter is addressed as follows in the same order as contained in the letter:

1. It is our intention to provide a separate means to add fringe benefits and other subsidiary costs when needed to assist in making administrative decisions in the future. On re-reading the sections where reference was made to this (Section 4: Plan - Budget and Work Program Subsystem Development, and Section 6: Plan - MMS and MDOH Accounting System Interface) it was noted that considerable clarification was required as the inference was that such a provision would be made if the MDOH desired it rather than that the information would be available on demand when needed. Revised pages 4-2 and 6-1 are attached and it is believed they satisfactorily clear up this matter.

2. It is our opinion that costs of contract maintenance should be recorded under the same activity coding system as is used for work done by state forces. The only difference is that units of work completed and cost are coded without the breakdown of resources used in the accomplishment. This approach is always important for cost and cost comparison records but is particularly significant when contract work is used to add to inventories of bulk material. By capturing the cost and work done as an activity, the slack time between adding to a stock pile and the establishment of new unit costs may be kept to a minimum. The same field reporting forms which are to be used to record work by state forces may also be used for contract work with a special coding indicator to note that the work was done by contract. Some agencies, however, prefer to use special forms and if this is the case for the MDOH that can certainly be arranged. In any event, that decision does not need to be made at present unless you or others on the Advisory Committee wish to do so. Revised page 8-5 (first paragraph) is attached reflecting the way in which it is intended to collect the costs of contract maintenance.

   The cost of utilties and their relation to activities is a somewhat more complex matter. If it is wished to capture the contributing cost of any item to an activity, it must be so indicated on the ADAM as a "Material" and in the case of unusual items described in the "Special Instructions". It is possible and reasonable, for example, to show the pounds of propane used to heat asphalt. If means are provided to use electricity or natural gas to initially heat material before taking it out on the road, this could also be included. On the other hand, the far more common case is that the cost of utilities cannot be associated with specific activities and therefore must be managed as an overhead item. In this instance, the maintenance management system as such is not involved and the records should be kept as they are now or as future modifications of the accounting system may dictate. As in every generality, however, there are some items which do not fall neatly into established categories. Two examples, for instance, are electric power for rest areas and electric power for highway lighting. It is not recommended that payment for these be simply coded to the appropriate activities and made whenever the invoices happen to be received. If this is done, large cyclic variations occur in the cost records which can conceal facts which should be given administrative review. There are a number of possible alternatives for addressing this problem which depend upon the breakdown of costs desired by the Department and the willingness of the Department to invest money in the collection of such costs. For example: the cost of power to all rest areas could have one coding and an annual spread of such cost made to the activity for rest area maintenance; the cost of power to year-round areas could have one coding and the cost of seasonal ones another; the cost of power to all rest areas in one division could have a unique coding or the year-round, seasonal difference added to this as well; the

costs could be collected and presented as a unique item without being spread to the activity, etc. At some point during the management system development, decisions in regard to this matter should be made by the MDOH. This is particularly true if it is considered of significance for budget presentation purposes. It may be noted that all of the possibilities described above involve superimposing costs on ones previously established so the decisions need not be considered high priority items at this time.

3. Resources used (labor, equipment, and materials), their cost, and the results obtained from their use will be captured for all maintenance activities as part of the operation of the maintenance management system. This will be the case whether or not the funds are from the regular maintenance appropriation or generated from an accounts receivable or some other special source. The only difference is that all of the costs in the two latter cases must be collected in a unique identifiable cost center so an invoice or special accounting may be prepared. Provisions will be made for this and are so indicated in the second paragraph of revised page 5-3 which is attached.

4. As noted in paragraph 3 above, all materials used in the accomplishment of an activity will be recorded if so indicated on the ADAM. This is true for the various materials used in conjunction with Activity 7202, Application of De-icing Chemicals and/or Abrasives as well as all other activities. In addition to expressing your concern about the use of materials about which there is always considerable controversy in all snow belt states, this item also serves very well to accentuate the significance of having as accurate and complete ADAMs as the Steering Committee in cooperation with BTML can provide. The first paragraph on revised page 5-3 which is attached was written to respond to your concern as indicated in this item.

5. Table 3 on page 11-24 has been revised in accordance with your wishes. A copy is attached for your review.

6. As noted in paragraphs 3 and 4 above and as indicated in Section 5 of the report as modified and clarified by the revised page 5-3 (attached), all resources used in connection with the accomplishment of an activity will be collected if shown on the appropriate ADAM. This will be done by indicating them on a Maintenance Work Input Form and they will be costed and collected as part of the Management Information System. Labor, equipment and materials are straight forward but as pointed out for electric power in paragraph 2 above, indirect costs are more complex and must be addressed individually. As a general rule, if they can be associated with a particular activity, they are indicated on an ADAM and the means by which they will be collected shown. If not, they must be

included as an overhead item, either narrow or broad depending on the wishes of the Department, and their cost becomes essentially an accounting function rather than an inherent part of the management system. In any event, every attempt will be made during the preparation of the ADAMs by the Steering Committee and BTML to consider all of the items which make up the total cost of each activity.

7. The word "Expected" has been deleted from "Expected Low" and "Expected High" on page 1-4 as you requested. The revised page is attached for your review.

8. Revised page 9-7 from Section 9: Plan - Equipment Shop Scheduling and Reporting, is attached for your review. You will note that it contains a whole section which obviously should have been included in the report when it was submitted. It is hoped that this satisfactorily responds to your concerns about this item.

Your kind compliment in your letter of January 6 is most appreciated, and it is hoped that the attached page revisions as enlarged upon by this letter appropriately address the few concerns you raised. If they do not, please advise and additional steps will be taken.

Sincerely,

Martin C. Rissel

Martin C. Rissel
Project Director

MCR:dj:211D

Attachments

DEPARTMENT OF HIGHWAYS

TED SCHWINDEN, GOVERNOR

2701 PROSPECT

STATE OF MONTANA

HELENA, MONTANA 59620

January 20, 1982

Martin Rissel
Project Director
BTML
Helena, MT 59626

Dear Mr. Rissel:

The Advisory Committee for the Maintenance Management System has met and discussed your suggested changes to the external design report, as per your January 13, 1982 letter.

The Advisory Committee hereby accepts the External Design Report as revised, and BTML is authorized to proceed with Pase II of the contract.

Acceptance is made with the understanding that items No. 2 and 6 (as discussed in the January 13 letter) are not fully addressed to the satisfaction of the Committee. They will require more discussion and decisions during the development of the M.M.S. Every effort possible must be made to design the M.M.S. to accommodate 100% of all maintenance costs relating to maintenance of our highway system. The problem centers around indirect costs and how successful we can be in assigning the indirect costs to maintenance activities. A prime example is our sign manufacturing shop overhead costs. Whether this will remain as overhead cost, or broken down as an add on cost to each sign is a decision to be made.

The Committee has now conceded that we are developing a management system, and not an accounting system. It is recognized the expenditures shown in the M.M.S. reports will not coincide exactly with the SBAS reports, but we must do our utmost to make them balance. More and more we are realizing the training program set up and implemented to train maintenance people to report properly will be a key factor in the success of the system, as will properly developed ADAM's.

We will accomplish our goal by working together.

Sincerely,

L. S. Harris

L.S. Harris
Maintenance Systems Coordinator

LSH:dj:9D

cc: Gary J. Wicks
Mr. Lloyd Byrd
Advisory Committee (6)
George Swartz

AN EQUAL OPPORTUNITY EMPLOYER